Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

ICI

Signs by Superb Stamping Co. Ltd.

I.C.I. PLASTICS FOR ADVERTISING AND DISPLAY

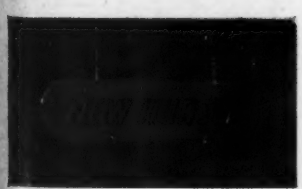
To focus interest on the uses now being found for I.C.I. plastics materials in the production of advertising signs and displays.

THE PLASTICS DIVISION OF IMPERIAL CHEMICAL INDUSTRIES LIMITED

is organizing an

EXHIBITION AT THE TEA CENTRE, LOWER REGENT STREET, LONDON

on February 15th - 20th



Signs by Acme Showcard & Sign Co. Ltd.

Invitations may be obtained from I.C.I. Regional Sales Offices in London, Birmingham, Manchester and Glasgow, or from:—

IMPERIAL CHEMICAL INDUSTRIES LTD., LONDON, S.W.1

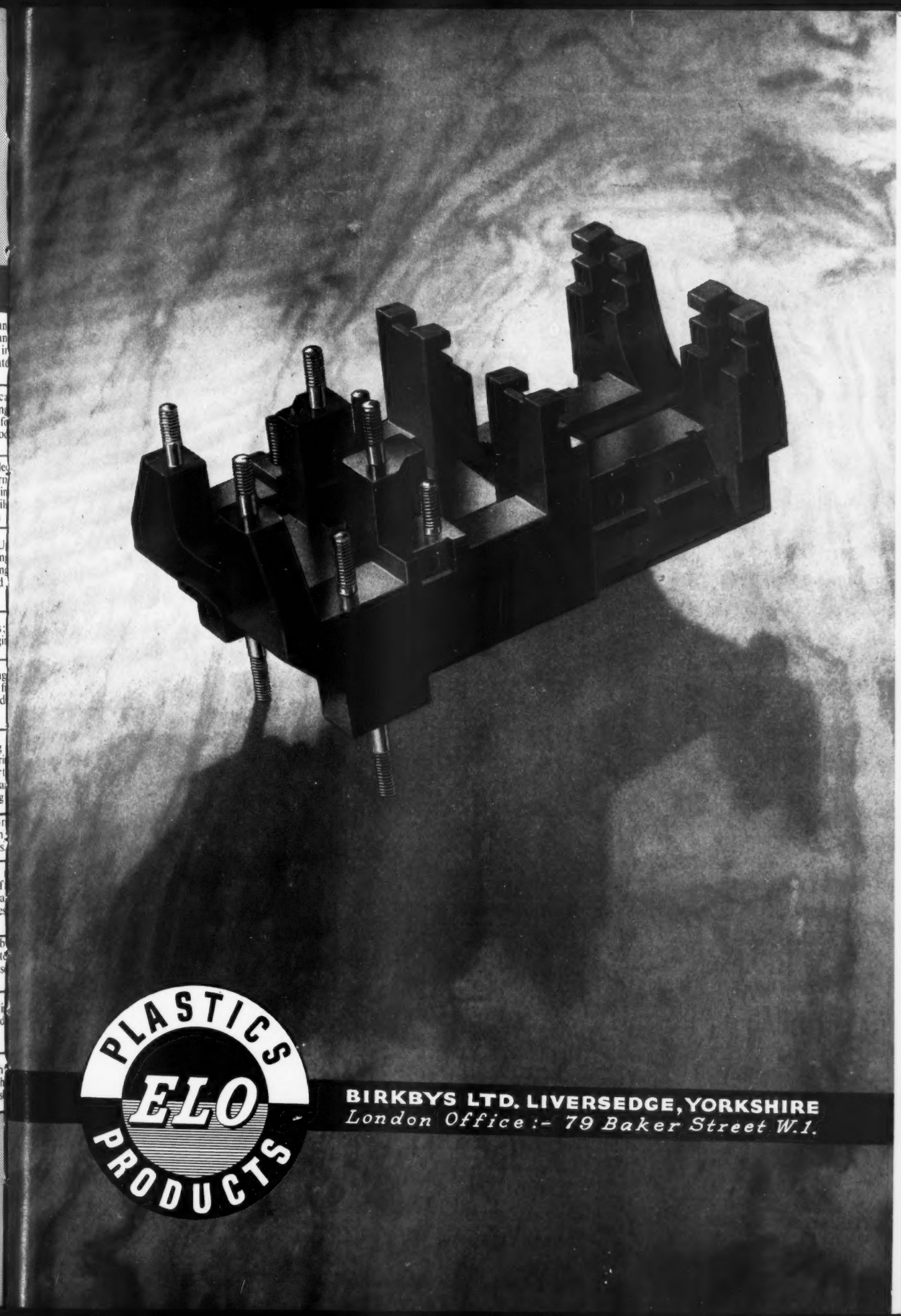
BX THERMOPLASTICS

in brief

PRODUCT	COMPOSITION	FORMS	PROPERTIES	TYPICAL USES
XYLONITE *Regd.*	Cellulose Nitrate	Sheets; Rods and tubes; Film; Solutions	Great toughness and rigidity. High transparency. Low water absorption. Good dimensional stability. Unlimited range of colours	Knife handles; Pens an pencils; Cycle pumps an mudguards; Drawing in struments; Cutting plat and bars
BEXOID *Regd.*	Cellulose Acetate	Sheets; Rods and tubes; Extruded sections; Film (also Tri-acetate); Solutions; Mouldingpowder	Tough and non-inflammable. High transparency. Unlimited range of opaque translucent or transparent colours	Lampshades; Optica frames; Toys; Packagin Injection mouldings fo industrial and fancy goo trades
LACTOID *Regd.*	Rennet casein	Sheets; Round and shaped rods; Tubes; Discs	Tough and non-inflammable. Wide colour range. Takes a brilliant polish	Buttons; Buckles; Ele trical components; Furn ture handles; Knittin pins; Pens and pencil and Games counters
BX P.V.C. *Regd.*	Polyvinyl Chloride	Embossed sheet, rod tubes and injection moulding compound	Tough and resilient. Will not rot or perish. Acid and chemical-resistant. Waterproof. Good electrical properties. Unlimited colour range	Handbags; Belting; U holstery; Shoe solin Rigid and flexible tubin Industrial aprons and gloves
VELBEX *Regd.*	Calendered P.V.C. sheet	Rolls 36″ and 48″ wide. 4/1000″ to 12/1000″ thickness	See BX P.V.C.	Rainproofs; Curtains; Fancy goods; Packagi
COBEX *Regd.*	Rigid Vinyl	Sheet	Dimensional stability; Good electrical and mechanical properties. Good chemical resistance. Non-inflammable	Deep draw moulding Slide rules; Lighting f tures; Advertising and d play
BX LAYFLAT TUBE	Polythene	Continuous lengths of tube in widths 2″ to 20″ and wall thickness of 1½″ to 5/1000″ or slit into sheets up to 20″ wide	Remains flexible in extreme cold. Water- and vapour-proof. Tasteless, odourless, non-toxic. Resistant to most acids and greases. Transparent	For protective packing foodstuffs; Engineeri and electrical part Chemicals; Tobacco a all general packaging
BEXTRENE *Regd.*	Polystyrene	Moulding Powder	High heat resistance and strength. Wide colour range. Transparencies of great clarity	Electrical insulator decorative item extrusions of all kinds.
ISOFLEX *Regd.*	Layers of corrugated cellulose acetate film	Standard pads 24″ x 24″ Flexible pads 23″ x 20″	Low thermal conductivity. Extreme lightness. Non-inflammable. Non-porous and non-absorbent	Air conditioning and frigeration insulation of kinds; Ships; Rail a road transport vehicle caravans
SARAN YARN *Regd.*	Polyvinylidene Chloride	Continuous monofilament. Diameters 10/1000″ to 15/1000″	Tough and flexible; rot-proof. Acid and chemical-resistant	Woven into Tygan fab for hardwearing upholst of all kinds. Also ins screens
BEXOL SOLUTIONS *Regd.*	Solutions of plastics in organic solvents	In liquid form	Various, according to purpose. Details on request	Sticking, staining, scali softening, laminating, d coating, spraying
BEXAN *Regd.*	Vinyl Resin	Brush monofilaments	Unaffected by water, acids and alkalis	Military hair brush ladies' and children's h brushes; Clothes brus

BX PLASTICS LIMITED

Higham Station Avenue, Chingford, London, E.4. *Telephone: Larkswood 5511*


PLASTICS
ELO
PRODUCTS
BIRKBYS LTD. LIVERSEDGE, YORKSHIRE
London Office :- 79 Baker Street W.1.

A NAME WORTH REMEMBERING . . .
Catalin Products
WHENEVER YOU WANT . . .
LAMINATED PLASTICS
CAST RESINS
P.V.C. SHEET MOULDING
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Let us share your problem. Our technical resources, modern production methods and skilled craftsmen are at your complete disposal the next time you have a plastics problem.

All information from :-

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A MEMBER OF THE Catalin GROUP

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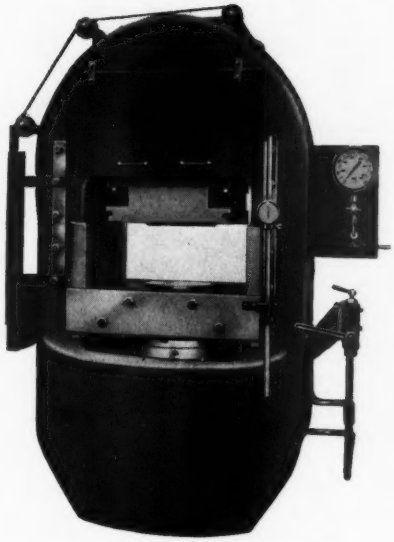
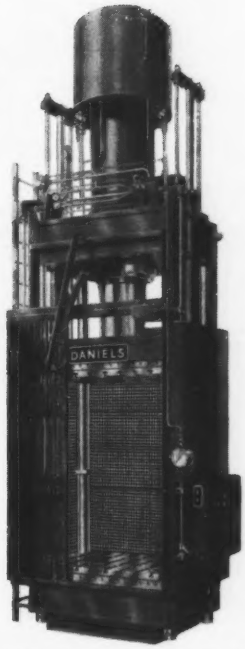
Tel.: Waltham Cross 3344

DANIELS MOULDING PRESSES
AND EQUIPMENT

high-quality compression moulding machine specialists



DANIELS 1,000-TON HOBBING PRESS



DANIELS 100-TON LOW-PRESSURE PRESS FOR GLASS FABRIC MOULDING

AMONG THE EXTENSIVE RANGE OF HIGH-QUALITY PRESSES AND EQUIPMENT OFFERED ARE:—

HYDRAULIC DOWNSTROKE DOUBLE-ACTING PREFILLING PRESSES FROM 50 TO 500 TONS. HYDRAULIC DOWNSTROKE SIDE-RAM PREFILLING PRESSES FROM 110 TO 150 TONS. HYDRAULIC UPSTROKE PRESSES FROM 12 TO 100 TONS. OTHER SIZES MADE TO ORDER.

LOW-PRESSURE MOULDING PRESSES. COMPLETE RANGE OF TRANSFER PRESSES. SPECIAL PRESSES.

500- AND 1,000-TON HOBBING PRESSES. PREFORMING MACHINES; THE LARGEST 125 TONS, PRODUCING 6-IN. DIAMETER PELLETS. PREHEATING OVENS AND MOULDING ACCESSORIES.

PRESSES WITH PISTON-CONTROL VALVES CAN BE FITTED WITH THE DANIELS PROCESS TIMER, WHICH PROVIDES ACCURATE CYCLE CONTROL.

WE OFFER THE SERVICE OF SPECIALISTS FOR THE DESIGN OF DIES AND MOULDS.

DANIELS 2B PREFORMER

LET US ASSIST YOU WITH YOUR MOULDING PROBLEMS

SOLE AGENTS:—

ALFRED HERBERT LTD · COVENTRY

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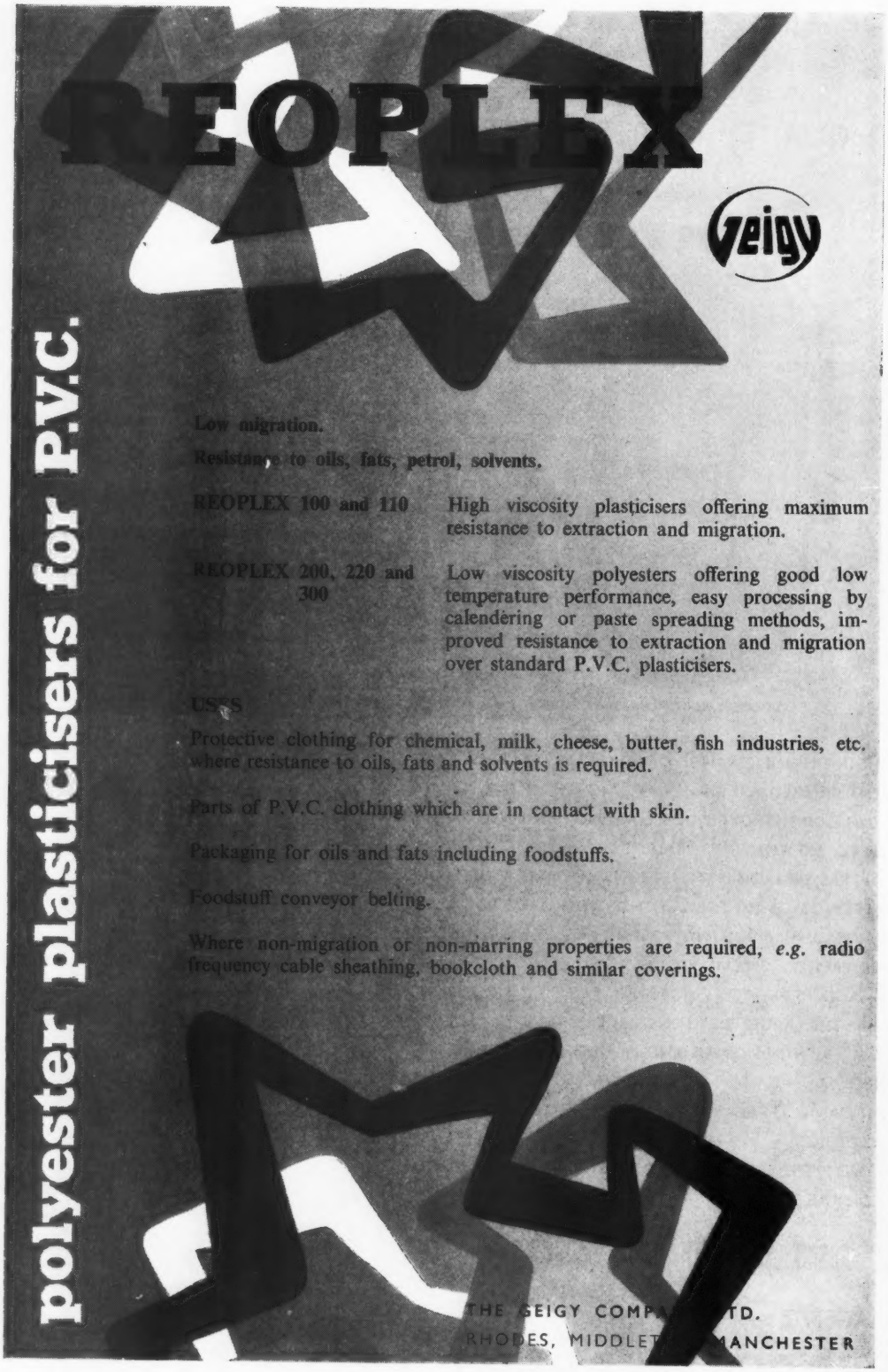
REOPLEX
Geigy
polyester plasticisers for P.V.C.
Low migration.
Resistance to oils, fats, petrol, solvents.
REOPLEX 100 and 110
High viscosity plasticisers offering maximum resistance to extraction and migration.
REOPLEX 200, 220 and 300
Low viscosity polyesters offering good low temperature performance, easy processing by calendering or paste spreading methods, improved resistance to extraction and migration over standard P.V.C. plasticisers.
USES
Protective clothing for chemical, milk, cheese, butter, fish industries, etc. where resistance to oils, fats and solvents is required.
Parts of P.V.C. clothing which are in contact with skin.
Packaging for oils and fats including foodstuffs.
Foodstuff conveyor belting.
Where non-migration or non-marring properties are required, e.g. radio frequency cable sheathing, bookcloth and similar coverings.
THE GEIGY COMPA TD.
RHODES, MIDDLET MANCHESTER
P.32

Out in front

AND STAYING THERE!

U·M·P PLASTICS

The mouldings illustrated show what has been achieved by U·M·P in recent development work for the Battery Industry.

A similar service is at the disposal of EVERY Industry interested in PLASTICS.

For Glass or Asbestos Fibre Reinforced Plastics, consult our Lamforte Section.

U·M·P

For Tubes and Plastics

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UNIVERSAL METAL PRODUCTS LTD.
SALFORD 6 LANCS. *Telephone:* PENDLETON 1631-2-3
LONDON OFFICE: ARGYLE HOUSE, 29/31, EUSTON ROAD, N.W.1. TEL. TERMINUS 2073

AKULON is an outstanding (nylon) type material which possesses highly interesting characteristics.

AKULON is of interest to the industrial field employing plastics for mechanical and constructional components where high strength, extreme toughness and resistance to heat are necessary.

AKULON can be supplied in the form of granules for injection and extrusion and cylindrical rods for machining.

Informative literature covering the characteristics for the moulding granules, rod materials and full technical data of AKULON will gladly be sent on request.

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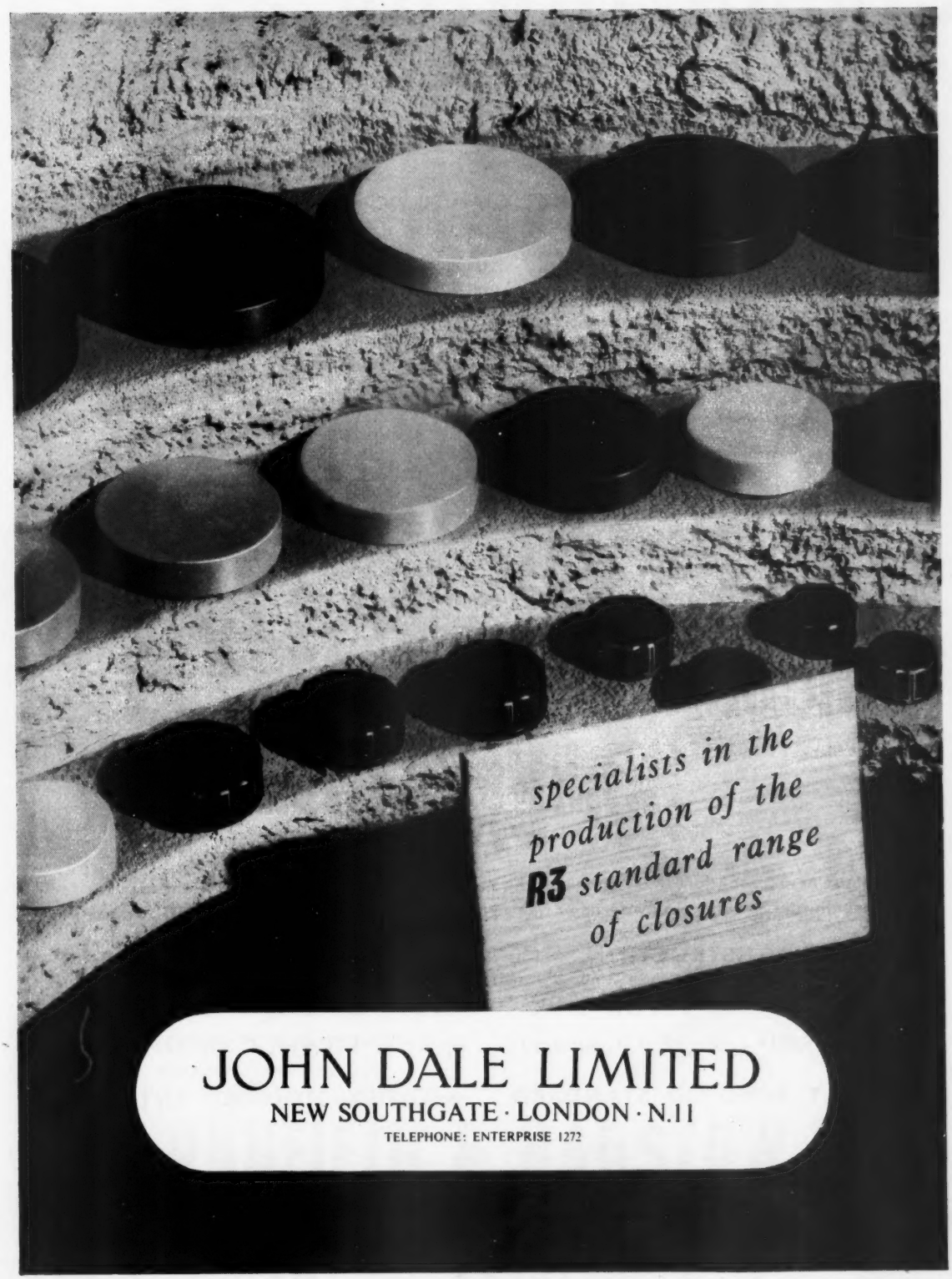
Sole Distributors for the United Kingdom

HERCULES POWDER COMPANY, LIMITED

140 PARK LANE, LONDON, W.1. Phone: MAYfair 8711


specialists in the
production of the
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of closures
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SIMON JUNIOR SIFTER

the little machine with BIG advantages

The robust new Simon Junior Sifter meets the need for a small, flexible and efficient machine for the screening and grading of powdered or finely granulated materials—with these BIG advantages:

- ★ METAL CONSTRUCTION
- ★ HIGH CAPACITY FOR SPACE OCCUPIED (approx. 4 ft. square)
- ★ EASILY REMOVED STANDARD SIEVES
- ★ INTERCHANGEABLE ALUMINIUM TRAYS
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- ★ EASILY MODIFIED INTERNAL FLOW
- ★ SIMPLE TO INSTALL & MAINTAIN

Write for leaflet P.S. 18

Industrial plant by **Henry Simon Ltd** SIMON ENGINEERING GROUP

HS134

STOCKPORT, ENGLAND

Quality

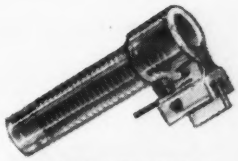
INJECTION MOULDINGS

P & B

INJECTION MOULDING

Specialists

DIAPHRAGM LUBRICATOR BODY in DIAKON
manufactured for and shown by courtesy of
Messrs. REAVELL & CO. LTD.



COIL FORMER in POLYSTYRENE
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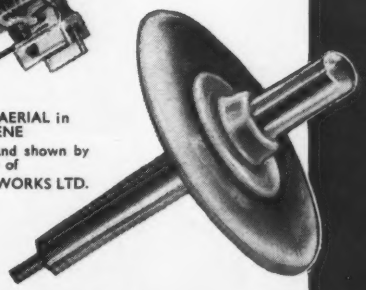


TRANSMITTER AERIAL in POLYTHENE
manufactured for and shown by courtesy of
Messrs. MITCHAM WORKS LTD.

If you require mouldings of the highest quality and dimensional accuracy at competitive prices — get in touch with

PUNFIELD & BARSTOW

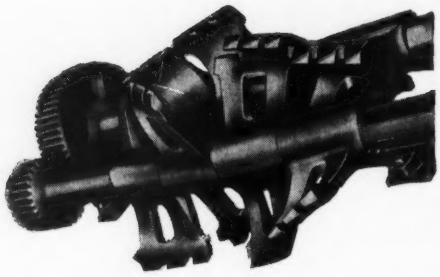
(MOULDINGS) LTD.

BASIL WORKS, WESTMORELAND RD., QUEENSBURY, LONDON, N.W.9

Telephone : COLINDALE 7160 and 7956

Telegrams : PUNFIBARS, HYDE, LONDON

How can the TRUE MIX assist your product?



NUMEROUS examples can be given where Beken mixers have assisted manufacturers by making possible economies in processing—

BY MORE THAN HALVING TIME REQUIRED— Synthetic rubber mixed with other materials where time has been cut from 6 to 2 hours; red oxide litharge with acid from 45 to 8 minutes . . .

BY MAKING FURTHER PROCESSING UNNECESSARY— Ensured perfect wetting without agents; with water paints and distempers made milling unnecessary . . .

BY REMOVING ACCEPTED DEFICIENCIES— Overcame balling; degree of wetting hitherto unknown; lumps reduced to powder or plastic state; always a uniform performance permitting minimum production time tables to be fixed; particle size not affected . . .

BY IMPROVING THE FINAL PRODUCT— Complete wetting without resultant lumps; no remaining pockets of unmixed solids; complete dispersion; lower temperature rises . . .

but every material has its own peculiarities, no generalisation can be made for mixing differing materials. The more difficult the mixing problem invariably the greater is the supremacy of the Beken mix.

Let us prove this fact by trying your product and show what TRUE MIXING can save you in time, power and cost.

THE BEKEN MIX is the TRUE mix

'DUPLEX' HORIZONTAL MIXERS
Sizes from 155 *c.c. to* 500 *gallons*

'PLANETEX' VERTICAL MIXERS
Sizes from 5 *gallons to* 100 *gallons*

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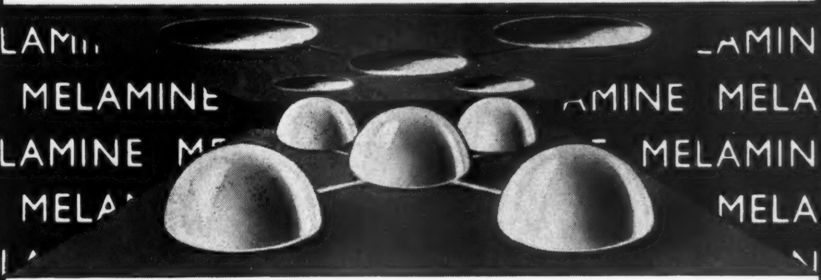
B·O·C MELAMINE
for
Industrial Mouldings



In the production of industrial mouldings the incorporation of melamine in the formula gives these advantages:—

Greater strength • Heat resistance • Low moisture pick-up • High arc and tracking resistance • Excellent dielectric strength • Dimensional stability

Write for Technical Bulletins, supplies and prompt service to:

CHEMICALS DIVISION

THE BRITISH OXYGEN CO LTD

VIGO LANE CHESTER-LE-STREET CO DURHAM. *Telephone:* Birtley 145

London Office: Bridgewater House, Cleveland Row, St. James's, S.W.1

CHEMICALS BOC DIVISION

FIRE-RESISTANCE *AND* FLEXIBILITY IN VINYL PLASTICS . . .

Vinyl plastics can now be made fire-resistant without loss of flexibility at low temperatures by the employment of antimony trioxide. The credit for this discovery goes to British Geon Ltd., whose successful experiments are fully described in their technical note G.T.N.9.

Fire-resistance was determined in each case by holding a strip of Geon 202 plastic 6" x 1" x 0.060 in a bunsen flame for 10 seconds.

With their approval we are able to announce that the antimony trioxide used by them in their experiments was our product TIMONOX, Cookson's white oxide of antimony of exceptional purity.

ASSOCIATED LEAD

Associated Lead Manufacturers Limited is a single Company which specialises in the manufacture of lead and antimony products.

IBEX HOUSE, MINORIES, LONDON EC3

CRESCENT HOUSE, NEWCASTLE

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ASSOCIATED LEAD PRODUCTS

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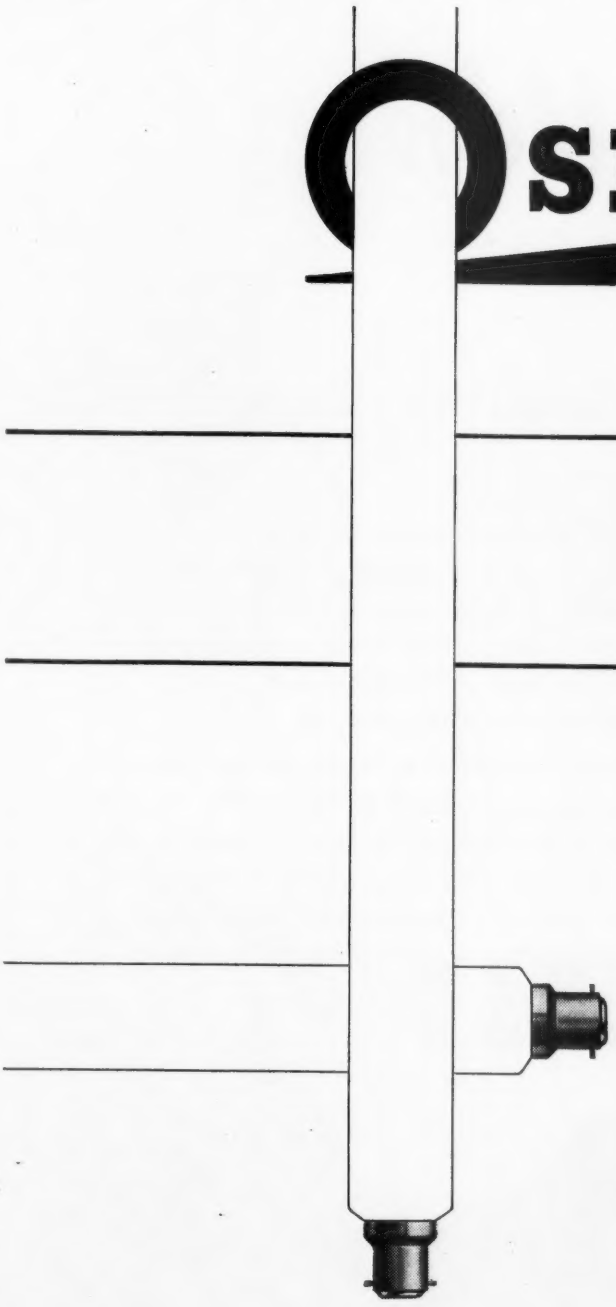
Keen interest in improved

Osram

TUBES



BETTER EFFICIENCY

Halophosphate powders have been developed which give more light. The average efficiency through life of the Osram 5 ft. Daylight and Warm White tubes is now up by 12½%.

GREATER RELIABILITY

New methods of automatically coating the cathodes result in even more uniform performance which makes for greater reliability.

IMPROVED STAMINA

Automatic pumping and carefully controlled ageing help to ensure long, efficient life which means more light for a given consumption of electricity.

Osram tubes for STAMINA

A G&C Product. The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2

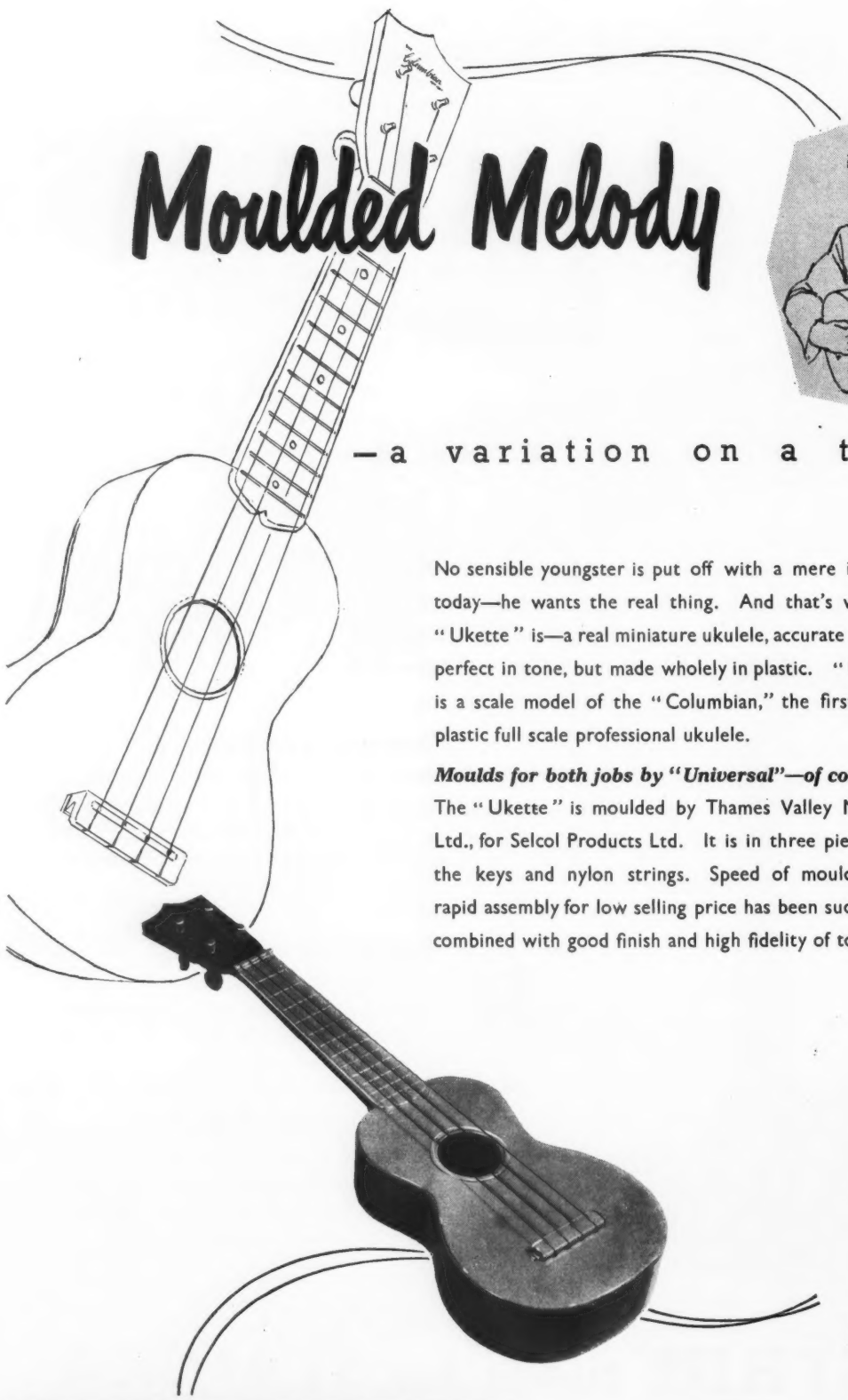
Moulded Melody

—a variation on a theme

No sensible youngster is put off with a mere imitation today—he wants the real thing. And that's what the "Ukette" is—a real miniature ukulele, accurate in shape, perfect in tone, but made wholely in plastic. "Ukette" is a scale model of the "Columbian," the first British plastic full scale professional ukulele.

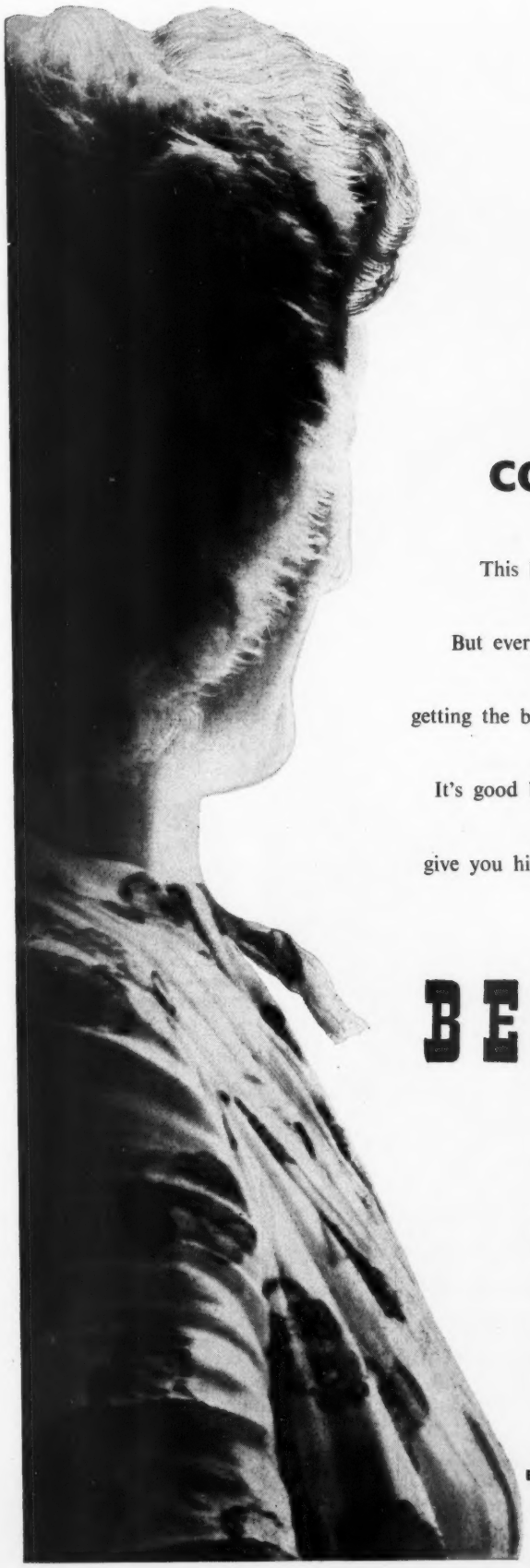
Moulds for both jobs by "Universal"—of course.

The "Ukette" is moulded by Thames Valley Moulders Ltd., for Selcol Products Ltd. It is in three pieces, plus the keys and nylon strings. Speed of moulding and rapid assembly for low selling price has been successfully combined with good finish and high fidelity of tone.



Universal Tools Ltd

TRAMWAY PATH, MITCHAM, SURREY
Telephone : MITcham 1624



thanks for the coal you've saved

This housewife knows nothing of boilers—nor stokers.

But every housewife in the country feels the benefit from getting the best out of every hard-won pound of coal.

It's good business too—for Bennis Stokers save labour and give you higher thermal efficiency even from low grade fuel.

BENNIS MECHANICAL STOKERS

A COMPLETE COMBUSTION ENGINEERING SERVICE

Bennis are designers and manufacturers of a full range of Mechanical Stokers to suit most types of Boilers, and are, therefore, able to do what no other manufacturer in this country can do, that is install the correct machine to meet the conditions and requirements prevailing in each individual plant.

Write for illustrated Brochures describing:—

The Bennis Air Draught Sprinkler Stoker.
The Bennis Coking Stoker and
The Bennis Unit Travelling Chain Grate Stoker.

Write for literature to Dept. P5

BENNIS COMBUSTION LTD., LITTLE HULTON, WALKDEN, MANCHESTER

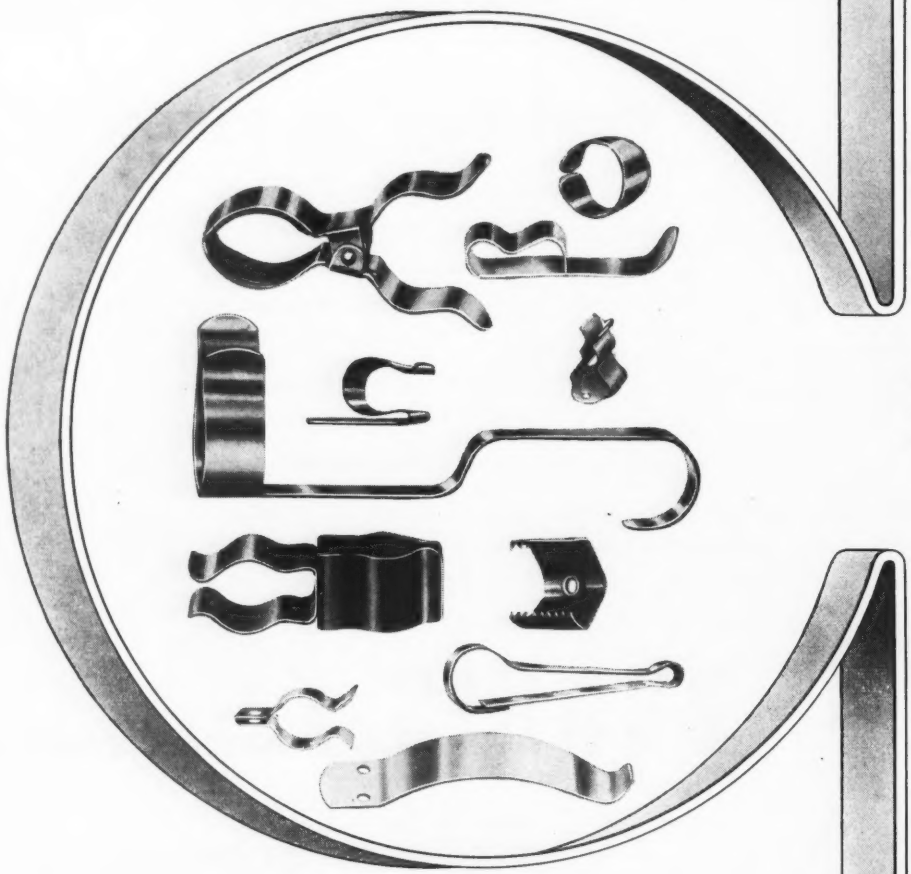
London Office: 28 VICTORIA ST., WESTMINSTER, S.W.1

2971

How are you fixed for CLIPS?

If you are having trouble with clips, bring your problem to us. We show here a few varieties, but these, mark you, are only a **very** small selection from our range of thousands of CLIPS . . . in every possible shape, size and quantity — in phosphor-bronze, brass, steel, stainless, plated . . .. for every trade and profession.

And if you want a 'special' let TERRY'S Research Department design for you — after all, we've got 98 years' experience behind us.



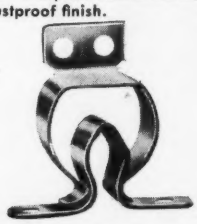
and 5 very popular 'numbers'

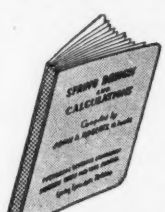
80 and 81 — general utility clips — for tool racks, etc., from $\frac{1}{4}$" to 2" from stock.

300 — an exceptionally efficient drawing board clip, 5/- a doz. (inc. p.t.) from stock.

257 — a useful clip in black enamel, from $\frac{3}{8}$" to $1\frac{1}{2}$".

1364 — a clip for kitchen cabinets — rustproof finish.





Really interested in springs? *This book* — **Spring Design and Calculations** — *packed from cover to cover with spring data, is yours post free for 12/6.*

TERRY *clips*

Sole Makers:

HERBERT TERRY & SONS LTD. REDDITCH (The Spring Specialists)

BIRMINGHAM · LONDON · MANCHESTER

HTA8

POLYMON COLOURS

comprise a new range, specially prepared for the colouring of plastics,
the first of which are now available.

They are particularly suited to all types of thermoplastics, except p.v.c.

Polymon Colours are finely ground powders
with excellent dispersion properties and adequate heat stability.

They can be used to produce bright, transparent colours,
or opaque effects can be obtained by adding white pigments.

For further information please apply to :

IMPERIAL CHEMICAL INDUSTRIES LTD., LONDON, S.W.1

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D.283

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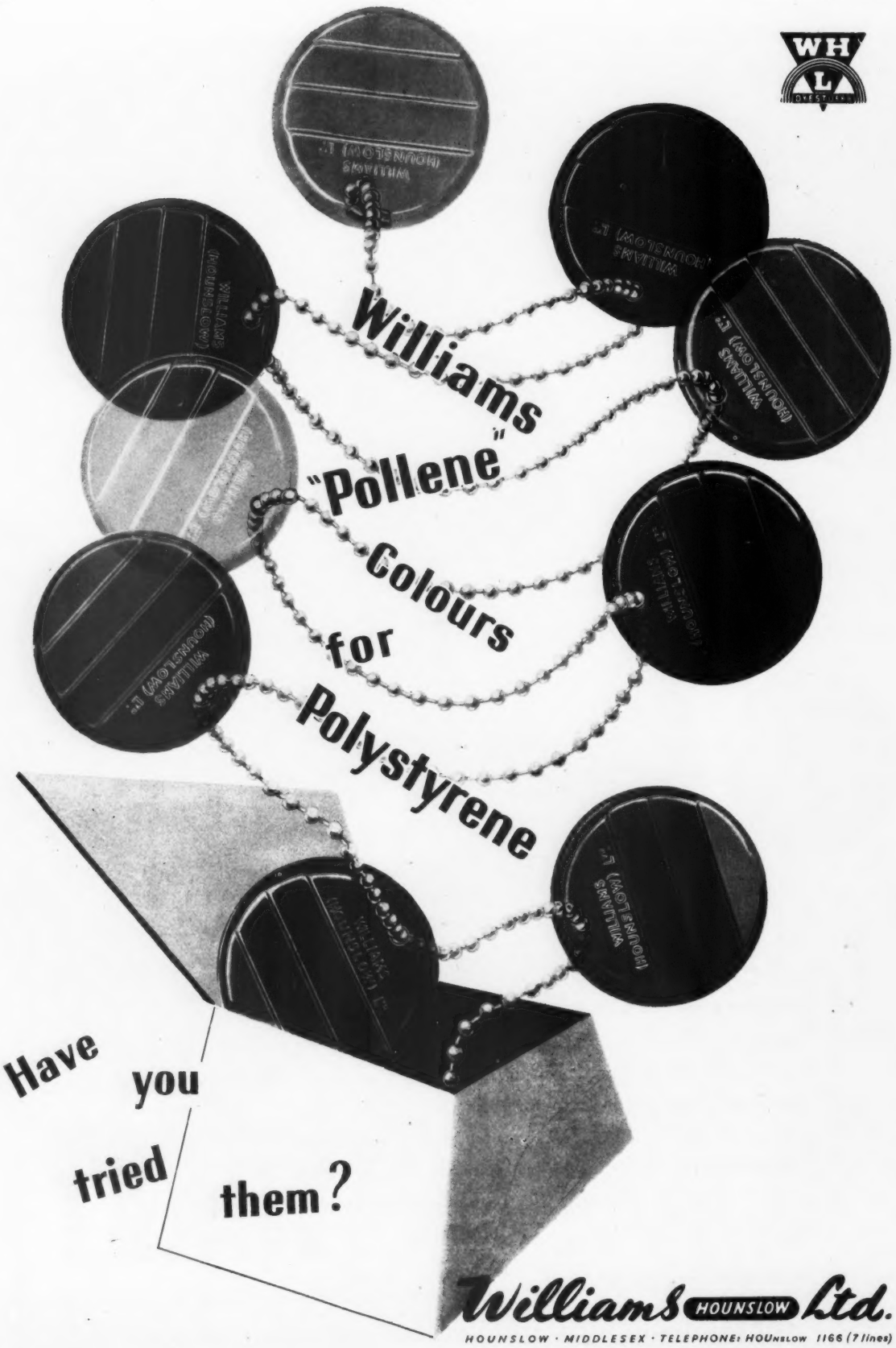
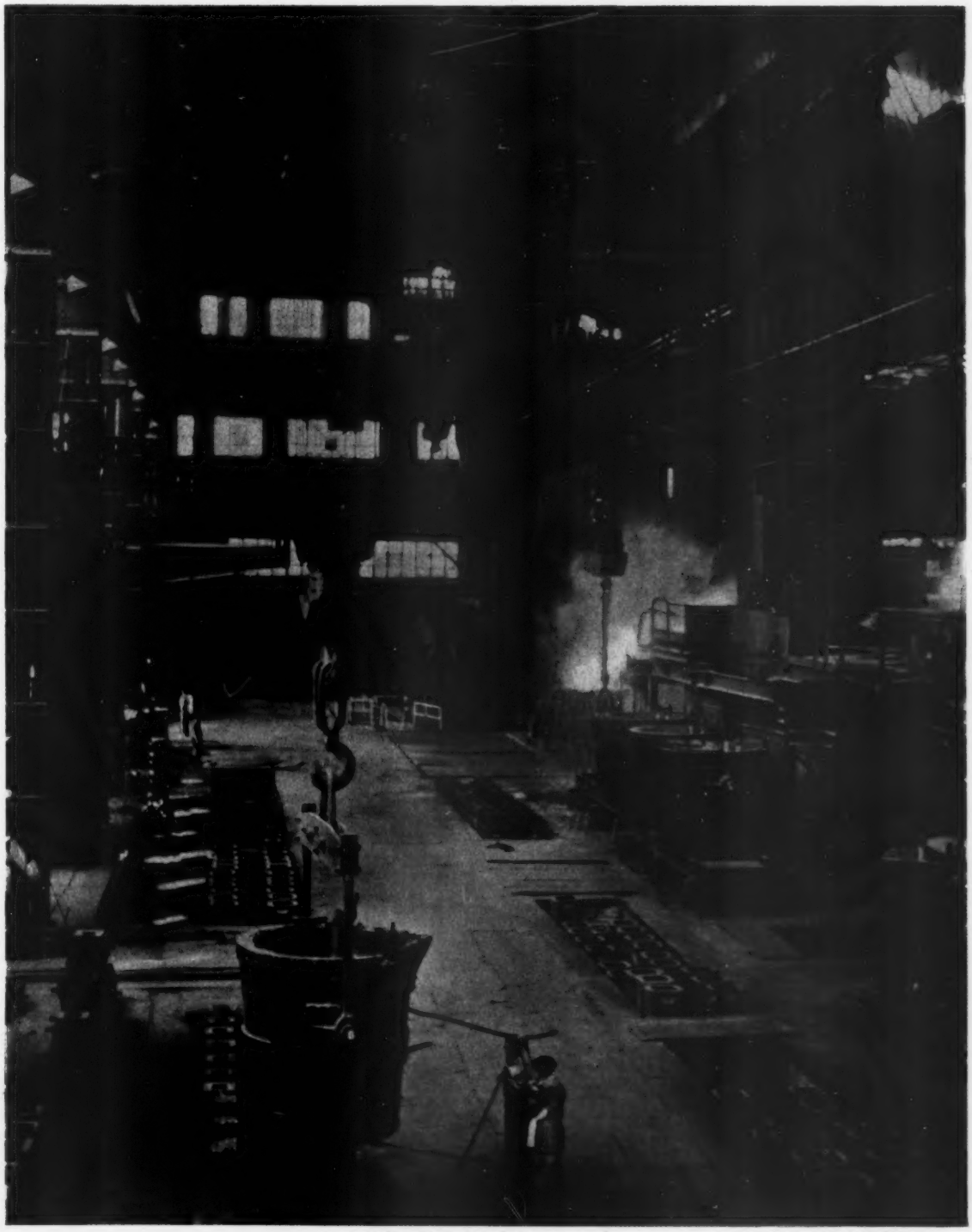

WHALL
Williams "Pollene" Colours for Polystyrene
Have you tried them?
Williams HOUNSLOW Ltd.
HOUNSLOW · MIDDLESEX · TELEPHONE: HOUnslow 1166 (7 lines)
MANUFACTURERS OF ANILINE DYESTUFFS SINCE 1877



Electric Melting Shop

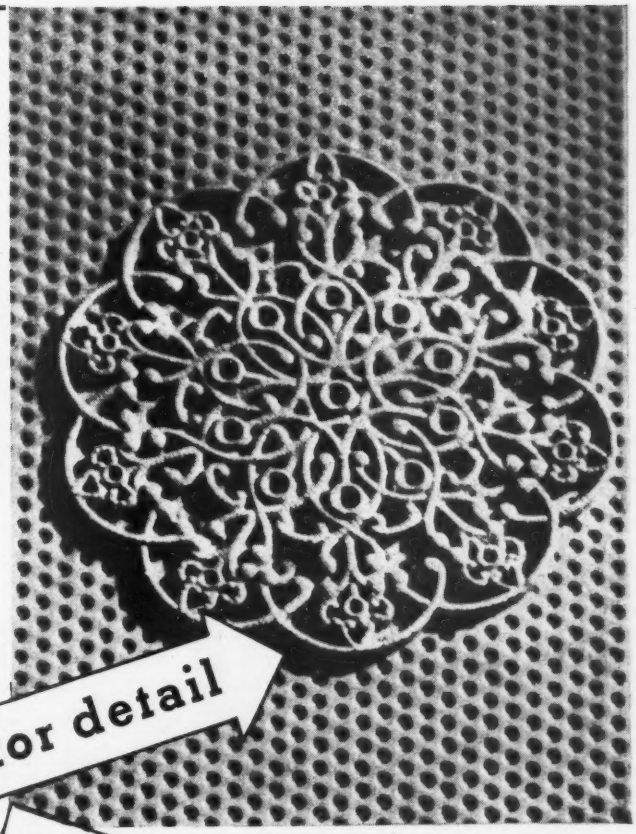
FIRTH BROWN

ALLOY STEELMAKERS · FORGEMASTERS · HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED SHEFFIELD

Vacuum forming—
the new technique for
'Cellastine'
TRADE MARK
Acetate sheeting

Six advantages for Vacuum forming with 'Cellastine'



1. Accurate reproduction of mould detail.
2. Generous depth of draw.
3. High lustre finish.
4. Choice of colours or transparent.
5. Economical production.
6. Quick cementing.

'Cellastine' is tough, resilient, lightweight, washable and printable.

Demonstrations can be arranged by appointment.

Enquiries to:

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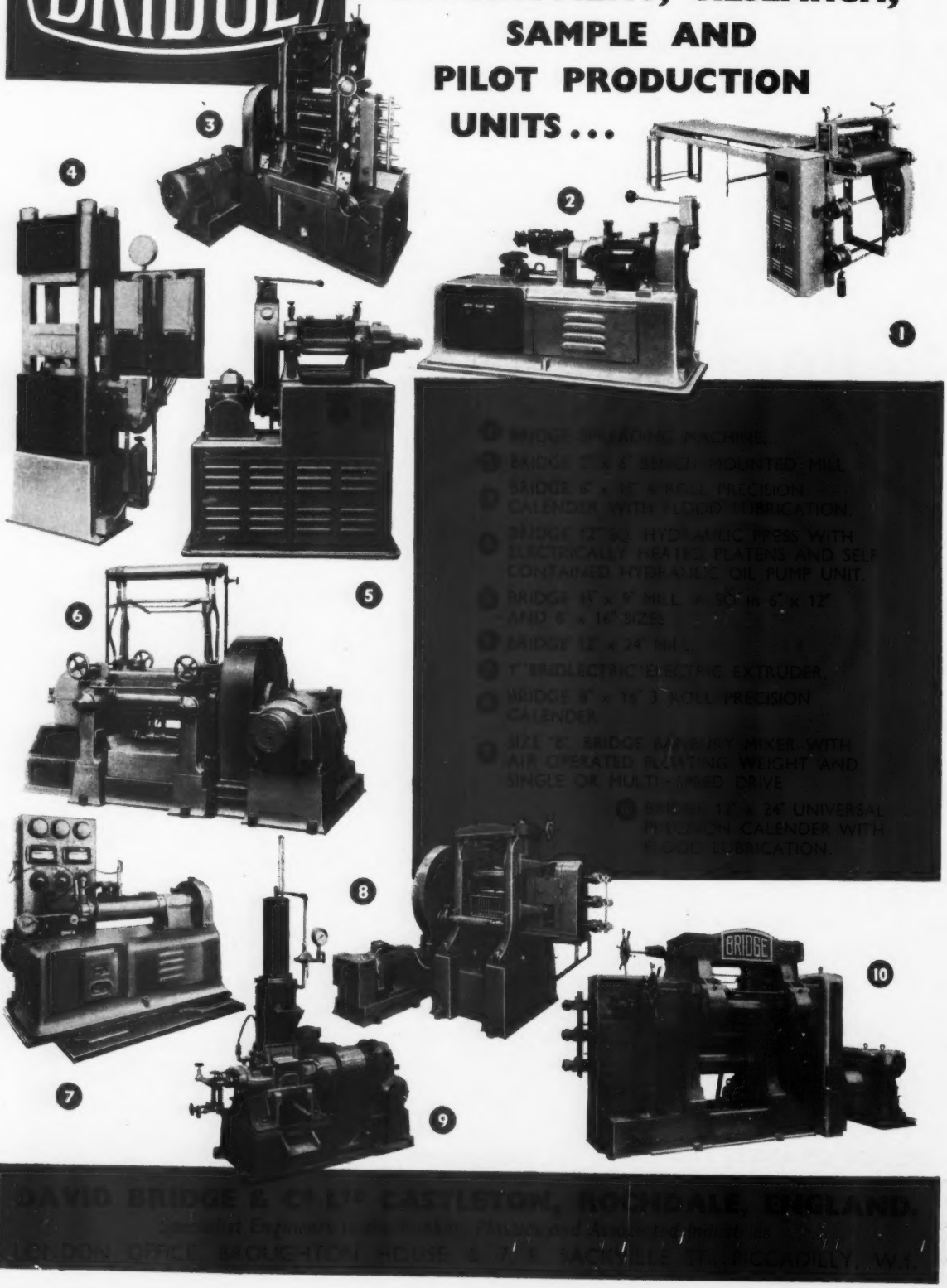
Plastics Division
Celanese House, Hanover Square,
London, W.1.

BRIDGE

Specify the best and be satisfied

FOR DEVELOPMENT, RESEARCH, SAMPLE AND PILOT PRODUCTION UNITS...



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Designer's Diary No. 12

The chair illustrated in this announcement is of special interest. Designed by John D. Vale of the British Industrial Plastics Ltd. Design Service, it gained a 1st Class award in a recent Outdoor Seating Competition, sponsored by the Council of Industrial Design in co-operation with the City of Birmingham Corporation. Reprints will be supplied on request.

The Product

Chairs for outdoor seating in public places pose an interesting problem for the designer. They need to be tremendously strong, yet light enough to handle; they must be very resistant to adverse weather conditions, yet need a minimum of maintenance; they should be gay and colourful in appearance, yet utilitarian enough to facilitate transport and storage.

The Design

A decorative metal frame onto which is rivetted a resin-bonded glass fibre seat panel, forms the basic specification.

It has been observed that many elderly or weary people need to 'heave' themselves up out of a chair, and although a conventional armrest was not considered necessary to enable this to be done, it was felt that some provision should be made for this action. Therefore, armlets have been provided. They not only facilitate handling, but also add structural strength to the chair.

The seat panel, set at an angle which prevents easy lodgment of rainwater, is anatomically correct. During fabrication, a printed identification label is permanently bonded into its underside.

The Material

For the frame, a welded construction of ½ in. diameter steel. For the seat, glass fibre impregnated with British Industrial Plastics polyester resin, a new material offering numerous advantages over the more traditional ones usually employed for such seats.

It has a very high impact and tensile strength, a surface which cannot be easily disfigured, and is available in fast, permanent colours. A seat panel produced in this material will not be unduly affected chemically or physically by exposure to the severest climatic conditions.

The B.I.P. Technical Advisory Service is always ready to help moulders in any problem which may arise regarding product design, mould design, materials and moulding techniques. This consultative service is freely offered, without obligation, and applies to moulding in thermoplastic as well as thermosetting materials.

BRITISH INDUSTRIAL PLASTICS LIMITED B·I·P GROUP **1 ARGYLL STREET, LONDON, W.1**

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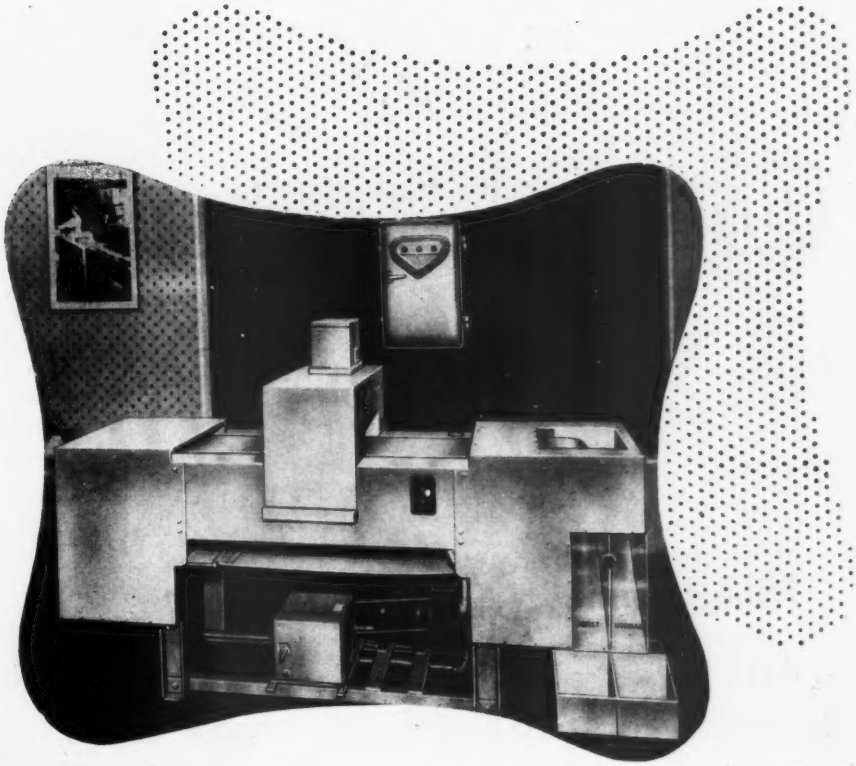

The ' Cintel ' Industrial Electronic Metal Detector Type 3.

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Average Tests	
Acid Value	385
Saponification Value	385
Mean Molecular Weight of Fatty Acid	145.7
Unsaponifiable	Trace
Iodine Value	0.8
Titre	13°C.

Average Composition	
Caprylic	90%
Caproic	3%
Capric	7%

CAPRIC ACID A102

Average Tests	
Acid Value	323.7
Saponification Value	323.7
Mean Molecular Weight of Fatty Acid	173.3
Unsaponifiable	0.5%
Iodine Value	1.2
Titre	30°C.

Average Composition	
Capric	90%
Lauric	7%
Caprylic	3%

CAPRYLIC CAPRIC ACID A101/2

Average Tests	
Acid Value	330/340
Saponification Value	330/340
Mean Molecular Weight of Fatty Acid	160/165
Unsaponifiable	1% max.
Iodine Value	1 max.
Flow Point	0/10°C.

Average Composition	
Caproic	Trace
Caprylic	35-45%
Capric	30-35%
Lauric	20-25%

LAURIC ACID A103

Average Tests	
Acid Value	276 min.
Saponification Value	276
Mean Molecular Weight of Fatty Acid	203
Unsaponifiable	0.5% max.
Iodine Value	1 max.
Titre	37.8°C.

Average Composition	
Capric	Trace
Lauric	90%
Myristic	9%
Unsaturated Acids	1%

Mould Lubricants. *Stearic Acid and Stearines in finely powdered form or flake and in various qualities are available in bulk*

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The H.P.M. straight-line hydraulic mould clamp permits moulds to be interchanged in a minimum of time. No adjustment is required for moulds of different thicknesses.

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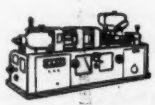
Moulding profits depend upon continuous uninterrupted machine operation. H.P.M.'s are of robust design; heavy-duty pumps, valves and controls guarantee trouble-free service.

A MACHINE TO SUIT YOUR JOB
There's an H.P.M. Injection Machine for every moulding need—9, 16, 32 and 60 ounces per cycle.

HPM



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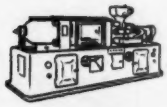

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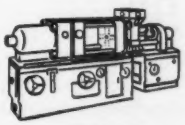

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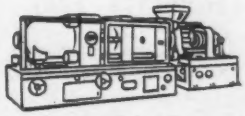

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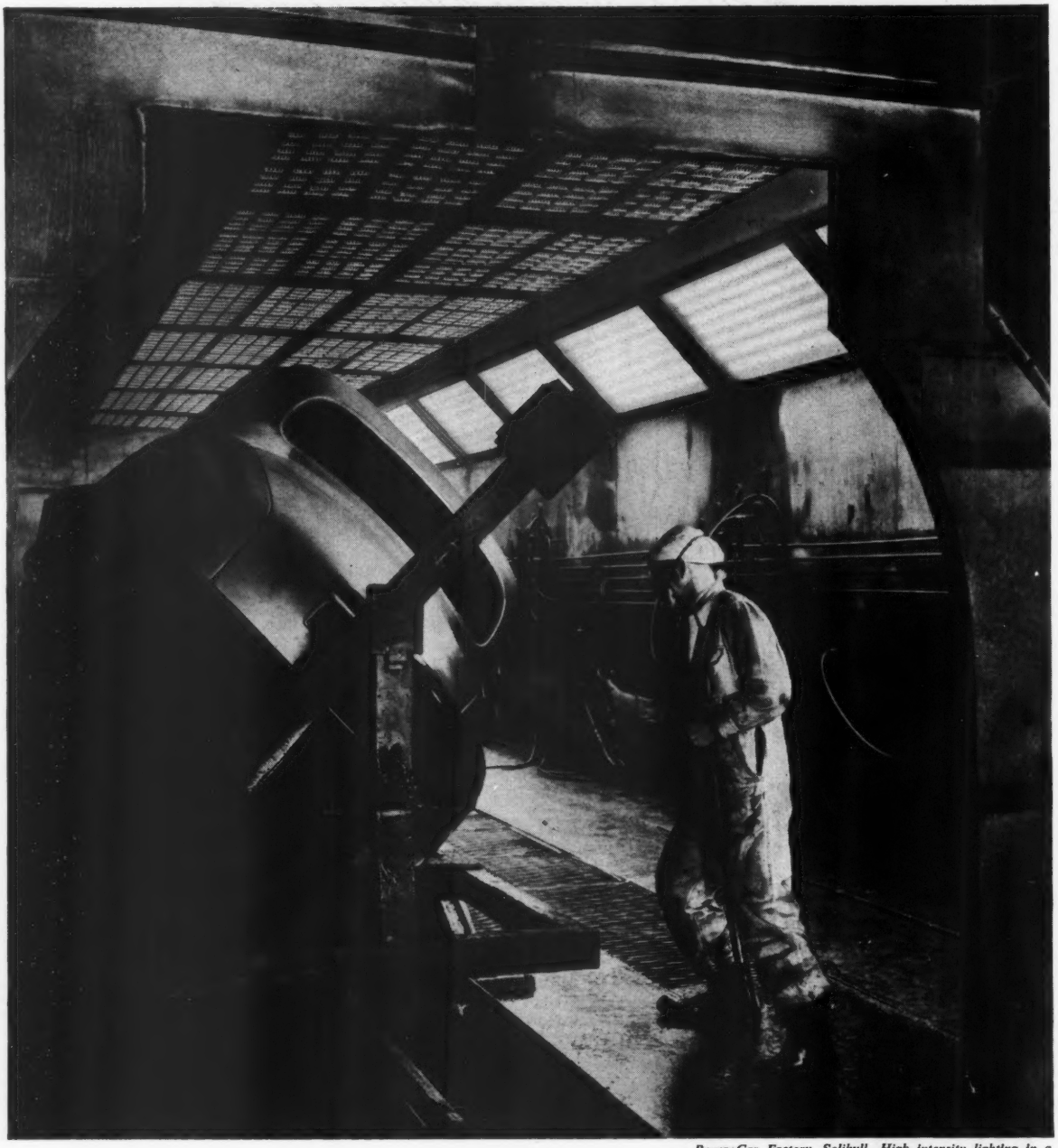

Rover Car Factory, Solihull. High intensity lighting in a body spray tunnel by fluorescent lamps in a glazed enclosure.

Tailored for the job

The lighting of many processes is vital to the smooth and rapid flow of work and to the quality of the finished product. For example, poor lighting could make a spray tunnel into a bottle-neck — each job taking a little too long, a little portion missed, a return to the spray line — and so the whole production line marks time. Whatever form it takes, good lighting not only helps to provide a satisfactory working environment but is an active production tool.

Fluorescent lighting is as good as daylight — only more consistent. It is efficient; it is economical; and it is *flexible*. You can ' tailor ' it, easily and exactly, to the special requirements of production at all stages.

HOW TO GET MORE INFORMATION

Your Electricity Board will be glad to advise you on how to use electricity to greater advantage — to save time, money, and materials. The new Electricity and Productivity series of books includes one on lighting — " Lighting in Industry ". Copies can be obtained, price 9/- post free, from E.D.A., 2 Savoy Hill, London, W.C.2, or from your Area Electricity Board.

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Issued by the British Electrical Development Association

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POLYSTYRENE
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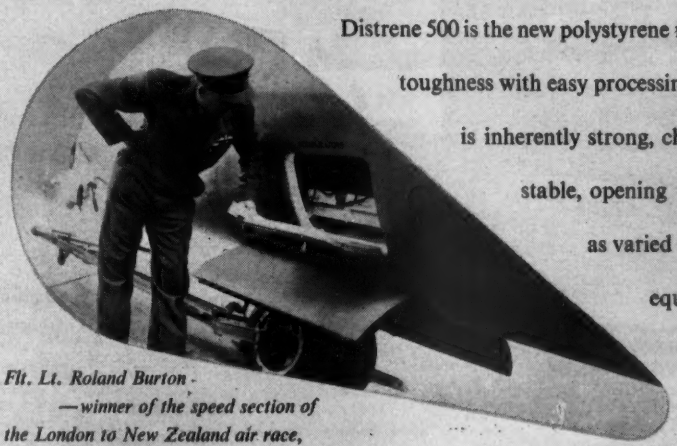
First in the London-New Zealand air race — the Canberra, using Oldham batteries moulded by Universal Metal Products Ltd. (U.M.P.) in DISTRENE 500.

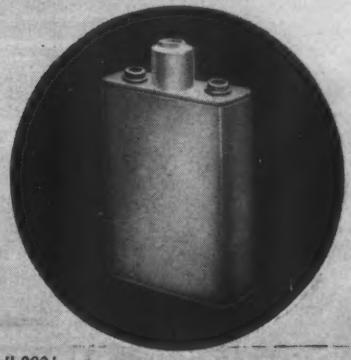
First in the field of battery box applications — DISTRENE polystyrene, because of its toughness and acid resistance.

a double 1st for 'DISTRENE'

Distrene 500 is the new polystyrene moulding material. It combines extra toughness with easy processing, either by injection or extrusion. It is inherently strong, chemically resistant and dimensionally stable, opening up new possibilities for applications as varied as toys, refrigerator components and equipment for the Chemical Industry.



Flt. Lt. Roland Burton — winner of the speed section of the London to New Zealand air race, inspecting the Oldham batteries on his Canberra just before take-off time.



Complete battery box cell for the Canberra, moulded by Universal Metal Products Ltd. (U.M.P.) in DISTRENE 500.

Data sheets are available on application to:

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The presses are designed for Top and for Bottom semi-automatic ejection, and the daylight is adjustable.

They are suitable for operation from a central accumulator system or by self-contained automatic pump unit.

They can be controlled manually or by an Automatic Cycle Control Unit. Electric, Steam or Gas heated platens can be fitted.

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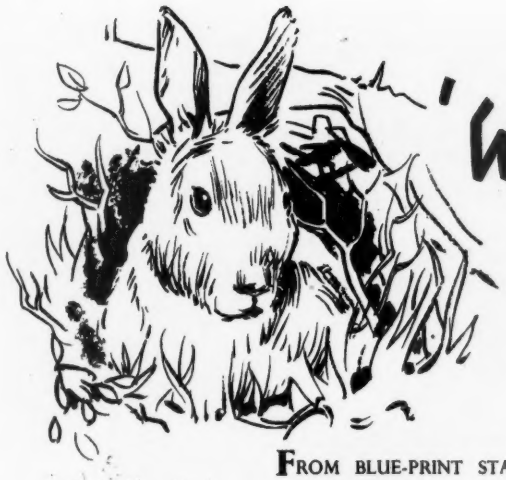

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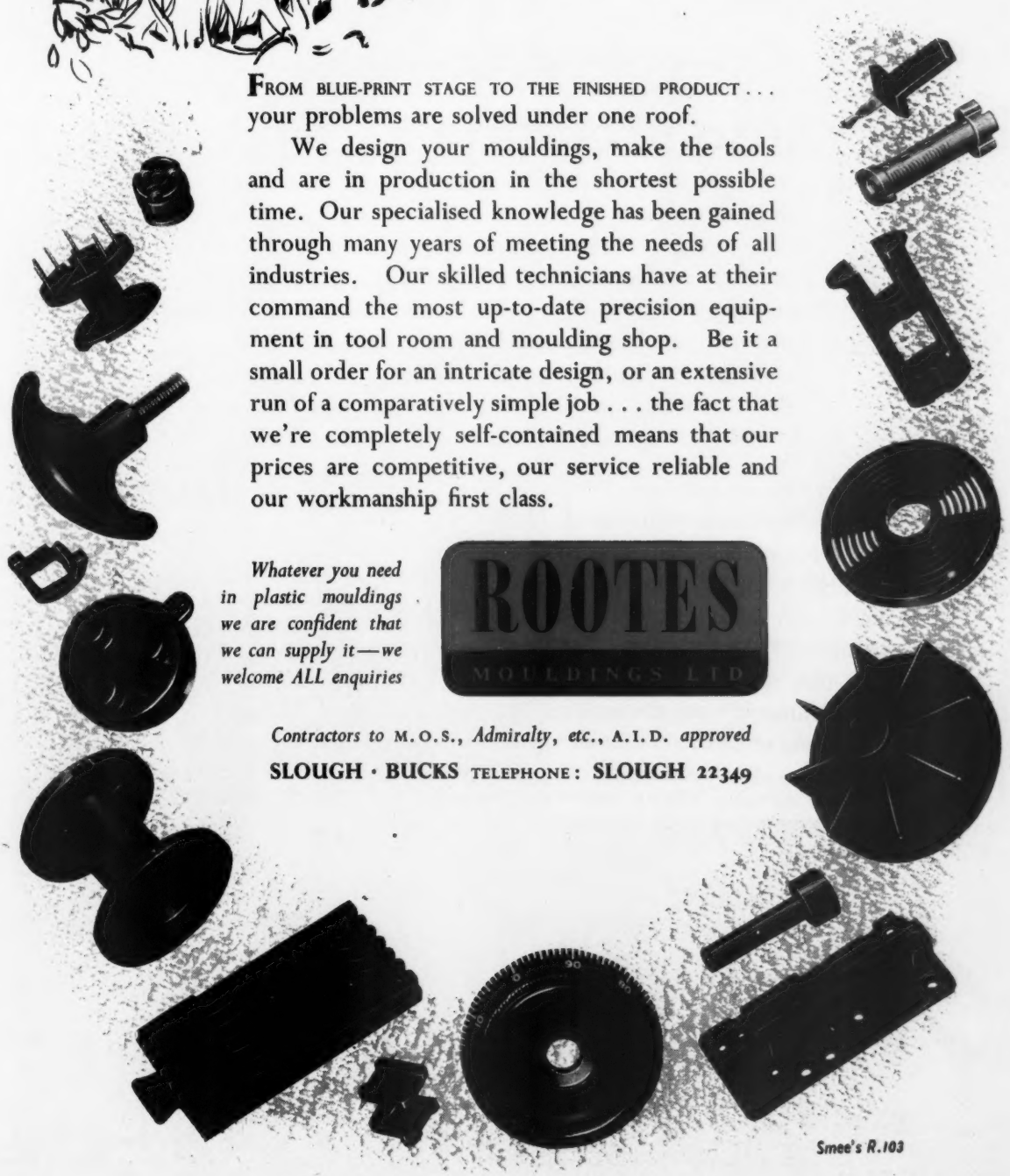

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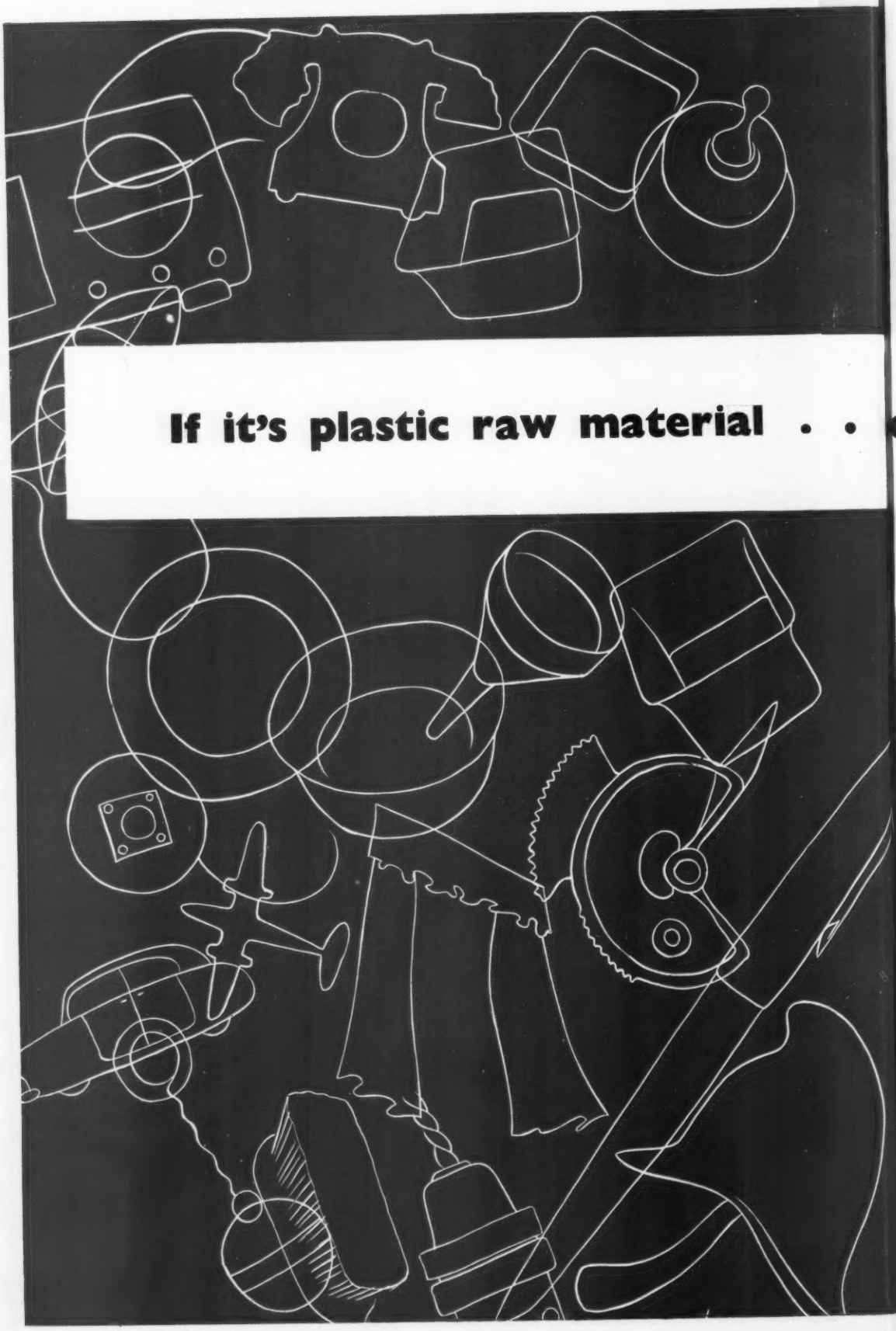
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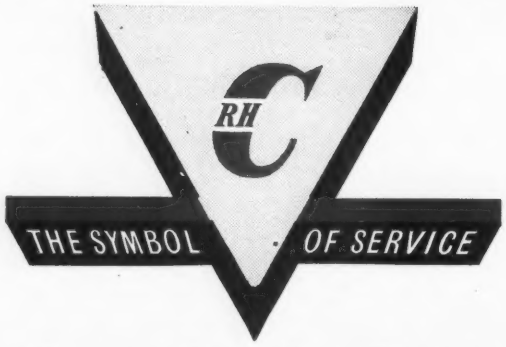

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STYRON **666 General Purpose** **777 Medium Impact** **475 High Impact** **700 Heat Resistant** **637 Light Stabilised**	For injection and compression moulding and extrusion.
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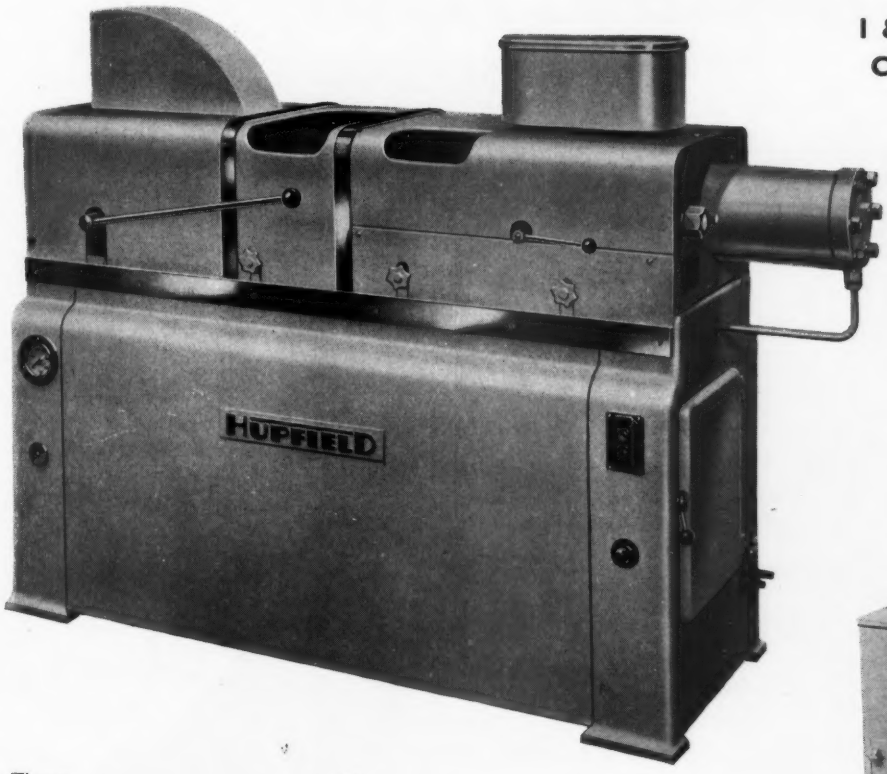
1 & 2 OUNCE CAPACITIES



These low priced hydraulic operated moulding machines, are designed for the rapid production of thermo-plastic mouldings on a low cost basis. Being operated by a single lever they are simple to use, ideal for female labour. Fitted with compensating feed mechanism and the latest Tem-Con automatic temperature control. All parts are standardized.

Completely self-contained with electric motor.

Machine moulding capacity	1 oz.	2 oz.
Moulding area up to	12 sq. in.	22 sq. in.
Plasticizing capacity per hour	11 lb.	22 lb.
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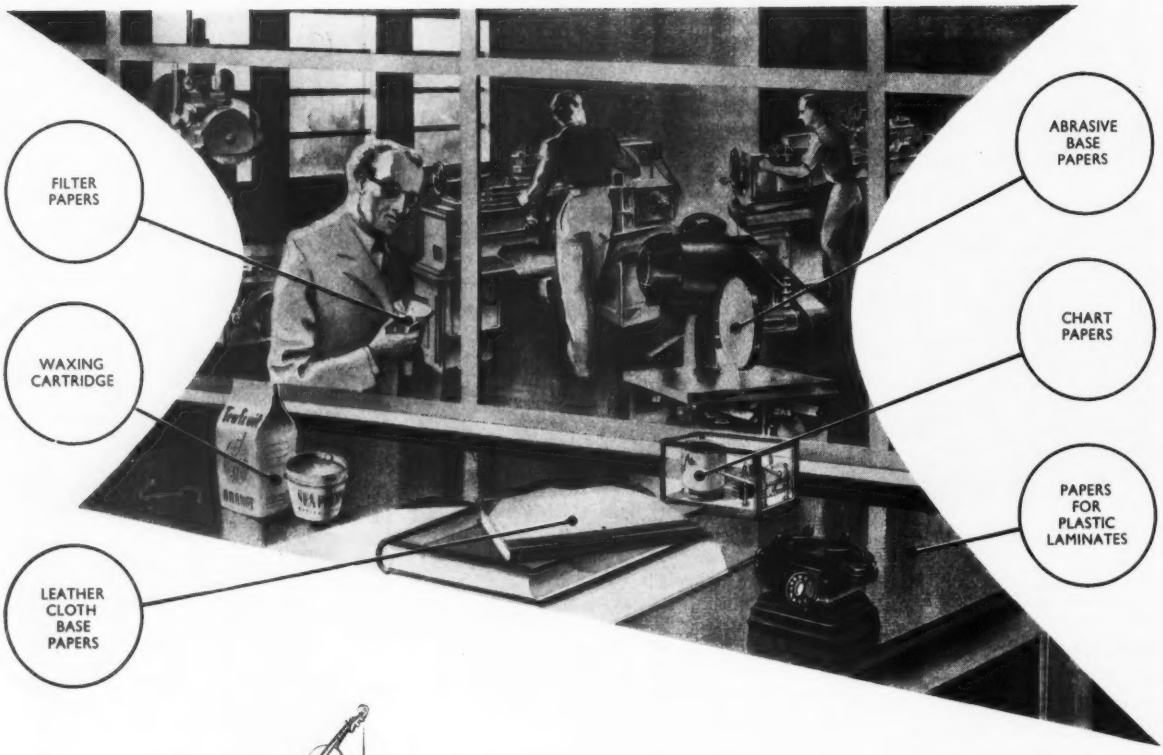

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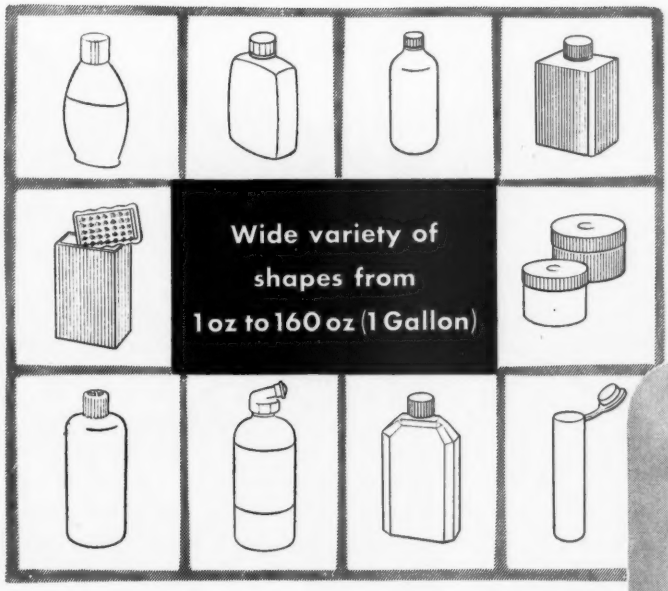

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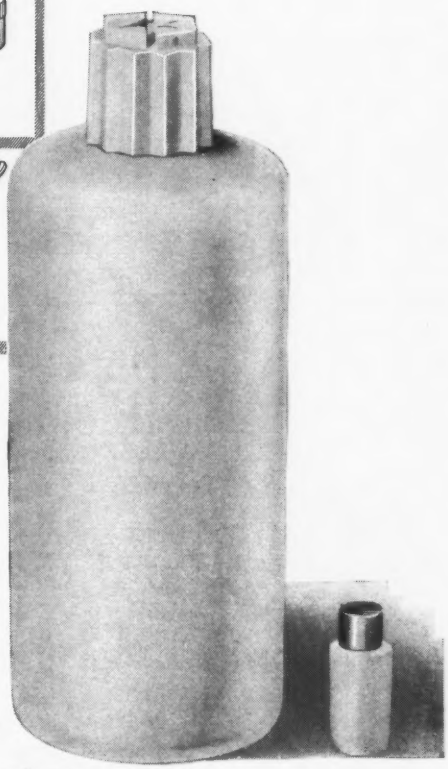

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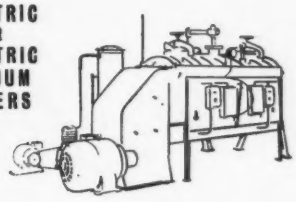

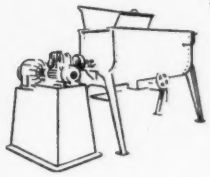

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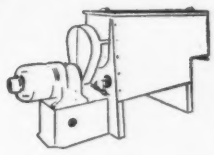

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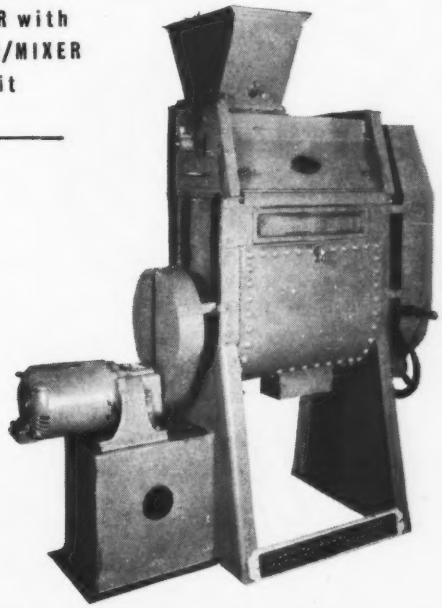

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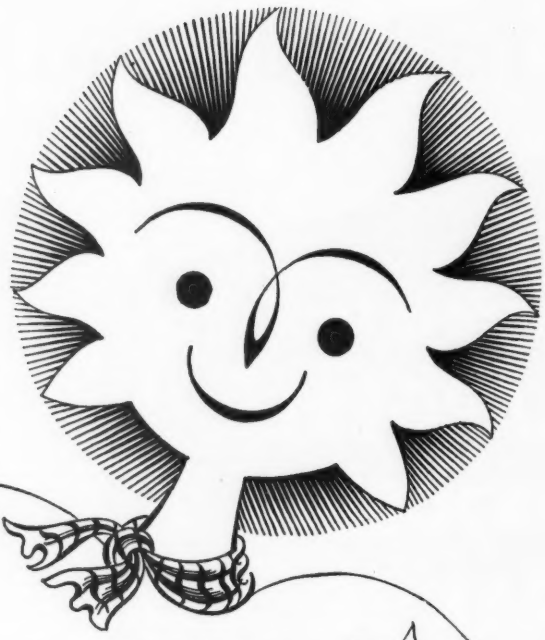

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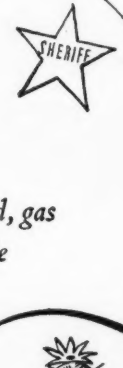

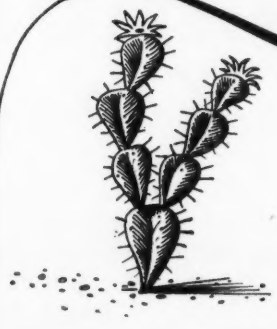

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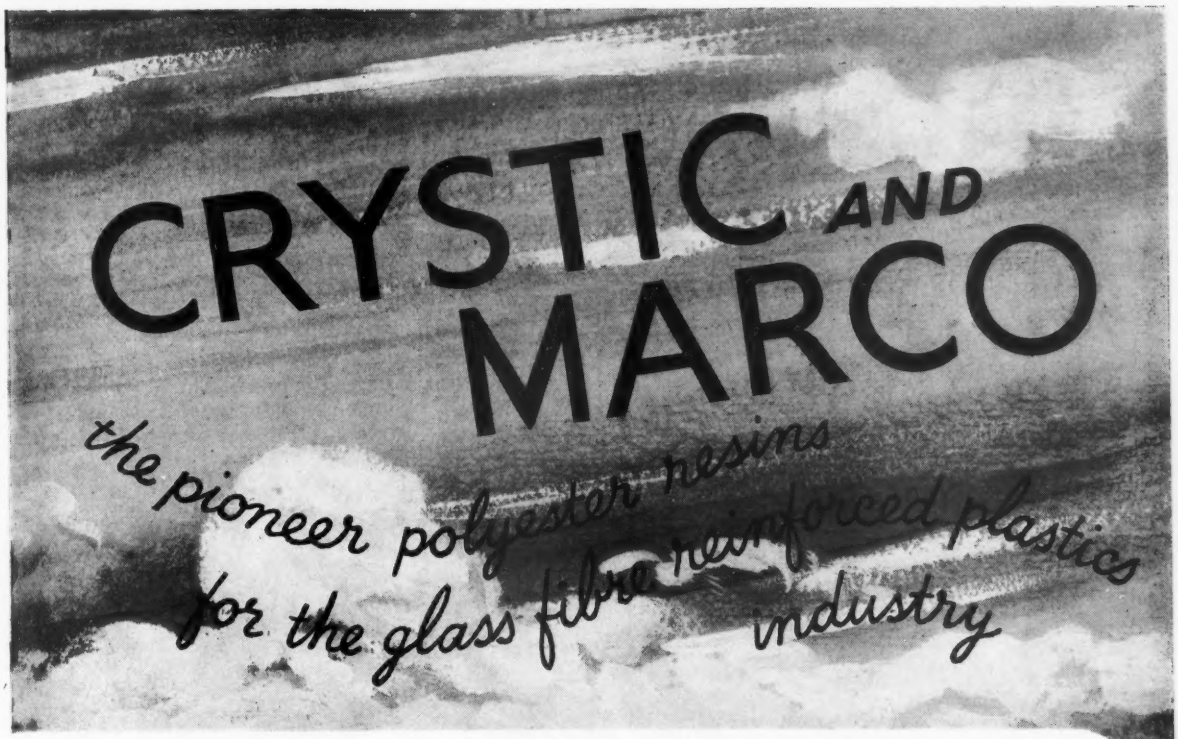

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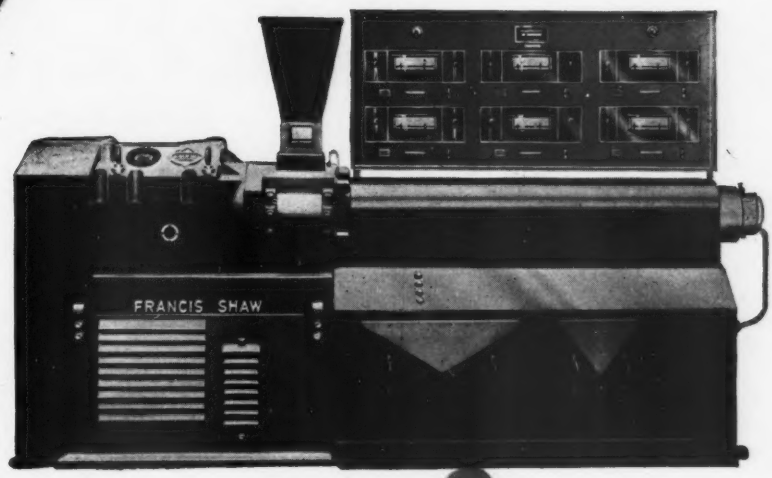

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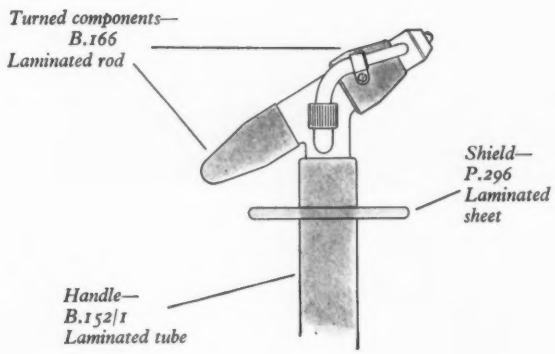

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T199

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
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Plastics

VOL. XIX. No. 199 FEBRUARY, 1954

EDITORIALS

Research

LAST month saw the opening of the new plastics research laboratories of I.C.I. Plastics Division at Welwyn Garden City. Its physical structure which we describe on another page in this issue is the most modern and complete that has ever been erected in this country and from it we expect results that will emulate and even surpass those that have already been obtained in the older laboratories at Welwyn and in other of the many I.C.I. factories from which came the developments of polymethylmethacrylate, polythene, Terylene and others. We wish the workers within them, the chemists, physicists and chemical engineers the best of good fortune.

What new plastic materials will come forth from these and the other laboratories of the world? Can we look forward to a host of polymers to follow the dozen or two dozen from which the plastics industry moulds and fabricates the units and components that enter so many industries? No doubt there will be new ones but it now seems clear that we are too severely limited in our raw materials to produce what was originally considered to be a supply of polymers infinite in number and of infinite variety.

An interesting, indeed fascinating, description of the trend of modern research in our field is given in the November, 1953, issue of *Research* in an article by I. Goodman entitled "Polymer Research." The author suggests, since in practice polymers must be made from relatively simple chemical molecules, that the intense research during the past thirty years has come close to exhausting the potentialities of polymers made on classical lines from readily available raw materials. As a result, future developments must rest on their application to unforeseen uses or by achieving specific results by flexibility in the organization of existing materials. The author describes how two recent developments in polymer research offer great promise in these directions.

As is well known, there are two types of polymer—the homo-polymer made from a single monomer, exemplified by say, polystyrene made from styrene, a low boiling point liquid, and the co-polymer made from a mixture of two or more monomers, exemplified by "high-impact strength polystyrene" made from styrene and butadiene, a chemical mixture (not a mechanical one) which results in the production of a material essentially possessing the characteristics of the homo-polymers made from each separate polymer and resulting in improved impact strength.

All such co-polymers so far produced industrially, however, are of what is called "random" structure—the arrangement of the monomer units is irregular. It is in the field of producing regularly structured co-polymers of long periodicity that one of the two new developments indicated above, operates. The changes affected by regularity are of great importance. Thus, while a random co-polymer possesses a melting point lower than that of either homo-polymer, the melting point of a regularly structured polymer increases with increased proportion of the higher melting point homo-polymer. Two types of such polymers have already been made. One type is linear in character with lengthy sequences of identical monomer units and are called "block" co-polymers. The second type is made by starting with a linear polymer and introducing reactive points along its structure and fixing new chains at long and regular intervals. This type is called a "graft" co-polymer. The author shows how in addition to high melting point co-polymers there can be produced by "grafting," for example, a series of polyvinyl alcohol chains on polystyrene, a co-polymer which can dissolve in both water and benzene, thus introducing new possibilities in emulsification processes. Another example the author gives is the treatment of polytetrafluorethylene (which is so difficult to manipulate in the factory) by grafting with polyvinyl acetate, resulting in a plastic material, which while retaining its high melting point and highly chemical resistant properties, yet can be anchored on to a material, e.g., paper or metal, which it is desired to protect. Again, the author visualizes similar treatment of cheap natural large polymers such as gelatin, cellulose or sea-weed "grafting" them with new properties they lack.

The second development referred to by the author is due to the discovery that partial replacement of one of the reactive compounds used in making nylon by another reactive compound of the same reactive length will result in a nylon polymer without any deleterious effect on its physical properties. A typical example given is that of 6 : 6 nylon normally made from adipic acid and hexamethylene diamine. Part of the adipic acid was replaced by terephthalic acid (this chemical is used in making Terylene). Instead of falling, the melting points showed a steady increase as the proportion of terephthalic acid increased. The introduction had not disturbed the crystallinity, so that this essential property for a high quality fibre was retained. This action was due to the fact that both the reacting portions of the adipic and terephthalic acids were equal in length and were transposable in nylon production. Such a transposition is of exceptional importance when we consider the necessity for flexibility in production or if supplies of the basic chemicals change. While, as the author states, the range of application of this second discovery may not be as important as "grafting," the process is illuminating and merits continued attention. We are now really in sight of achieving the "tailored" giant molecule, of producing, almost as an artist elaborates his theme, a great array of materials with pre-selected properties. There is no stagnation in the field of plastics.

Rubber and Plastics

THE remarkable and exciting possibilities that lie in the suggestion that natural giant polymers might lend themselves to "grafting" will immediately raise the question of its application to natural rubber in order to introduce into it specific large molecular groupings and thus specific properties it does not possess at present. If this were possible, it would clearly have a profound effect on the whole economic structure of the natural rubber industry and possibly on the synthetic rubber industry also. Another interesting effect might result—the bringing together in closer collaboration of the rubber and plastics industries.

We have already referred in this journal to these two

industries, long segregated because of their origins, the one natural and the other synthetic. The segregation has never been a scientific one and was based quite logically on important differences in the applications of rubber and of the early plastics and on the even more profound differences in production: the raw material of the one being obtained from a tree and its giant molecules ready-made by Nature, the other entailing production from simple chemicals but involving complicated chemical processes and costly chemical plant. The scientific and technical studies of all the giant organic molecules that exist lie, however, in exactly the same field of chemistry and physics.

It is pleasing to read, therefore, in *The India-Rubber Journal* of January 16, the views of Dr. Schidrowitz, the famous rubber technologist and teacher in that field of technology, on this very subject of closer collaboration. He suggests that while "the rubber and plastics industry are not (yet) married, they are definitely walking out together." Certainly most if not all the large rubber-producing and rubber-consuming companies are now very much interested in those vinyl polymers and co-polymers which have shown properties of value to their industry.

Dr. Schidrowitz refers to a recent visit he made to the newly-opened National College of Rubber Technology and to the fact that in addition to its prime function of providing facilities for the study of rubber and its technology, there is also a strong plastics section and that there are at present 150 students studying rubber technology and 65 students in the plastics division. These figures are impressive and lead the writer to suggest a new designation for the institution—a title such as "National Polymer College." We heartily agree.

We ourselves were also present at the opening of the College and to the lunch that preceded it. We listened to many excellent speeches on the growth of the rubber industry and to the excellent facilities which the College provided for advanced study. But we heard no word in any speech referring to the plastics side or to the plastics technical workshops with its splendid array of processing plant and its instruments for analysis, testing and control. We thought the omission a great pity.

MOULDING POWDER AND SHOT

Up the Garden Path

It has been a good thing for our industry that many have grumbled and rejected low quality goods in plastics; the quality has improved steadily as a result. But there is no end to the awful rubbish that some workers in metal foist on a long-suffering public. The metal industry deserves a good deal that is surely coming to it. This struck me very forcibly recently when I wanted a steel barrow for the garden—wooden ones are even heavier because of their construction and mine had at last decomposed. One type I saw was put together (I won't use the word "constructed") using five sheets of thin, badly galvanized steel, bolted with ungalvanized bolts that had long rusted in the shop. The body would clearly drop into five separate pieces after a couple of years hard work. What was worse, the handles were not tubular, but merely of flat plate $1\frac{1}{4}$ in. by $\frac{1}{8}$ in. thick. You can imagine the effect on the hands after a day's work. However the shop manager (not the manufacturers) had seen the drawback and had thoughtfully slipped a couple of ordinary rubber cycle-handle covers over the ends; obviously they did not fit and slipped off when handled. While the handles were stupidly designed, at least they might have been covered with tightly fitting p.v.c. tube. It is clearly time that the better companies in the agricultural implement field put an end to this type of inefficiency and studied the demands of their market. One day somebody will design a barrow for small garden work with the body made in one piece from high-strength laminate rather like the new chairs we have already seen, fitted with extruded p.v.c. handles or extruded aluminium handles covered with p.v.c., and similarly treated "legs." We shall then give the gardening fraternity, which is enormously large in this country and spends a lot, something that is strong, light in weight, rustless, that cannot rot by exposure to the elements and is warm to the touch—gardeners cannot wear nice woollen gloves even in the coldest of weather while working.

◆ ◆ ◆

Tracing Oil Patches

Some two or three years ago I noted the use of very tiny injection moulded polythene plates (about $\frac{1}{4}$ in. diameter) in tracing the migration of fish by fixing the plates to their gills. Today I read that thousands of sealed plastic envelopes are being dropped into the Atlantic by aircraft of Coastal Command, from the Bay of Biscay to a point between Scotland and Iceland. The object of the new experiment, which has been devised by the National Institute of Oceanography, is to study the velocity and direction of the ocean currents in these regions in order to trace the origins of greatest concentration of oil patches which drift on to our western shores. Each envelope contains a postcard so that the finder may forward information regarding position to the Institute. About 12,000 will be dropped throughout the year.

◆ ◆ ◆

Pretty Pretty Weskit

This note has nothing to do with plastic boats or plastic motor cars or other emanations of the polyester-bonded glass-fibre industry, but so many of our daily newspapers refer to glass-fibre as being the new marvel of the 20th century that I expect few know how old it really is. I don't myself, but when I was very young I remember the announcement of the installation of a glass-fabric fireproof curtain in an old London theatre. There seems no evidence of its value compared with the older asbestos curtain, and of course there was no organic bond. A much older reference to glass fabric I came across recently in the autobiography of W. Graham Robertson, the artist and scenic designer to most of the great actors of the late 19th and early 20th century. He tells of his mother who once met Charles Dickens but didn't like him. She didn't like him because of his waistcoat "which was of spun glass and shone like all the rainbows of the heavens reflected in all the diamonds of Golconda." It dazzled her, and she could not "beyond it, find The Man." I wonder why Dickens wore it; the "glass-waistcoat" was surely not on the market. I remember seeing the famous Professor H. E. Armstrong appear at a chemical society dinner wearing a waistcoat dyed with some of the first synthetic dyestuff ever made, Mauveine. I disliked the colour intensely but we all knew why he wore it—to honour the Englishman, Sir William Perkin, who, in 1856, synthesized the dye and created for the world a great branch of the chemical industry. Perhaps Dickens wished to promote a new industry.

◆ ◆ ◆

Control of Silver on Films

A report from the Institute of Technology tells of some interesting work carried out by the Armour Research Foundation on the use of radioactive silver in measuring and controlling the amount of silver in photographic film emulsions and in finished film. By its means the amount of silver in a small sample of emulsion can be measured in about three minutes with great accuracy and in film moving at the rate of one foot per second. The amount of radioactive silver used for the test is of the order of one part in ten thousand billion parts so that the film is unaffected by its presence.

DOGSBODDY.

Three-dimensional Nameplates

By A. B. GLANVILL, A.M.I.Mech.E.
Chief of Methods and Design, E. K. Cole, Ltd. (Plastics Division)

After discussing the various types of nameplates in general use, the author proceeds to review the technicalities involved in their manufacture. Design problems are discussed, as well as methods of finishing three-dimensional nameplates.

WHILE nameplates moulded in plastics have been used now for several years they were, for quite a while, largely confined to a few leading manufacturers of such expensive items as cars, refrigerators and washing machines. However, they have tended to become much more universal of late and now attractive moulded nameplates can be used on even moderately priced articles. Nevertheless, their possibilities have been far from fully exploited and this field offers the designer many opportunities for original and unique styles. The following notes have been compiled to assist in a better understanding of the potentialities of this type of nameplate and to offer some guidance on their design.

Types of Nameplate

The smallest type of nameplate in general use is the button emblem, frequently used on such items as radios, electric irons, electric heaters, caskets, and other comparatively small domestic articles. Usually round in shape for economy in tooling costs, they may in fact be any shape, and seldom exceed ¾ in. in diameter. Normally they carry only the initials or insignia of the manufacturer and general practice is to limit the colour scheme to two colours as otherwise the masking when painting becomes impracticably difficult. Emblems can conveniently form a focal point in the general design of the article such as a centrepiece of a handle or knob or the centre of a decorative motif, while they may also be used as a cover for a pilot light and thus become illuminated.

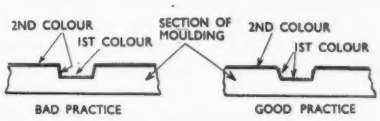
Larger emblems are also employed on major products, the best known of these being motorcar horn buttons. They are also used on refrigerators and washing machines and are frequently of complex and ornate design. They are of necessity comparatively expensive, but since they are almost works of art and form a centrepiece on expensive articles the investment is well worthwhile. These emblems are again often circular and measure up to 3 in. in diameter, but other shapes are not uncommon. Usually they have at least three colours and occasionally up to five colours and the mouldings are often massive with deep domes or rebating.

Mouldings carrying the actual name are generally relatively flat on the front face, with the design built around the lettering of the name, the decoration being limited to recessed fluting of various styles. The colour scheme is often limited to one colour for the lettering and a second colour for the background. In size they vary from 1½ in. to 8 in. in length.

The foregoing classifications are of course purely arbitrary and in fact no design of nameplate need be influenced by convention.

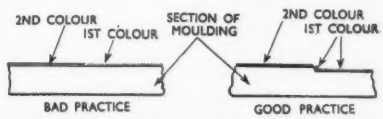
Finishes for Nameplates

The most common method of applying colour to nameplates is by the use of paints, a special range of which is now available to suit all types of plastics materials. It is essential to specify the material being used when designing, as paints compounded for use on one material are often quite unsuitable for use on another. These paints are quick



For ease of masking the sides and face of recessed portions, such as lettering, should be finished in the same colour.

drying, available in any colour and supplied in spraying, brushing and paste-filling grades. In addition, metallic paints are also used and gold, silver and bronze are common. A full range of polychromatic colours is obtainable, particularly effective on nameplates and worthy of much wider use. A number of luminous compounds of varying brightness and life are available for such items



Changes of colour should not occur in the same plane but should be separated by a change in section of the moulding.

as dials. Employed on nameplates of the "three-dimensional type" are vacuum-plated finishes obtained by depositing a very thin film of brilliant metal on the surface of the moulding. This operation is carried out in special plant under high vacuum and a large number of mouldings can be treated simultaneously. By suitable masking, selected areas of the nameplate can be treated and others left plain —thus the lettering can be vacuum-plated while the background is subsequently painted. The most common finish is that of aluminium, which is readily deposited and gives a brilliant mirror-like silver surface, but other metals, such as pure gold, silver and copper, can also be deposited. Generally, to obtain colours other than aluminium it is usual practice to first spray on a tinted lacquer (assuming the nameplate is in clear material with the letters recessed in the back and the plate viewed from the front) and then to deposit aluminium on the lacquer. The aluminium is then seen through the coloured lacquer and by this means not only can any colour be obtained, such as gold or copper, but also any desired shade of colour such as light gold or red gold. The vacuum-plated film, however, because of its extreme thinness has no wear resistance and must be protected with a coat of lacquer or paint. This can either be purely a backing coat or the paint used to colour the nameplate background and which being also sprayed over the vacuum plating provides the necessary protection. In general, vacuum plating is not employed on front surface nameplates.

A more recent method of employing vacuum-plated finishes is that of leaving a clear area on the nameplate and fitting behind it a portion of vacuum-plated polystyrene foil. Stamped out to the desired shape and made slightly larger than the actual clear area of the nameplate, it is held in position, close against the back face of the nameplate moulding, by any convenient means such as adhesive tape. The effect is almost the same as vacuum plating direct on the moulding except that a silvering aura occurs due to the gap between the moulding face and the foil. In large mouldings in particular this method offers economies in finishing, while the foil can be obtained in gold, silver, single and multi-colours. It is obviously only suitable for nameplates whose backs are protected and unseen.

Another method, hot stamping with coloured foil, is very popular for stamping names and information on the front of mouldings, although it is also used to a small, but increasing, degree for colouring three-dimensional nameplates. It is possible to stamp in several colours although at increased cost, while translucent foils are also available. Large stamped areas should be avoided and heavy and small type should be balanced

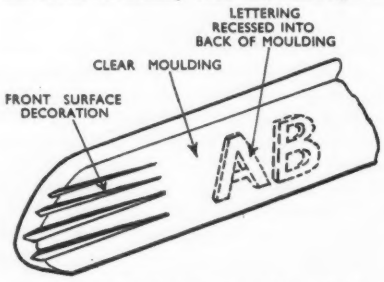
out. The foil is applied with pressure and if the areas of printing are grossly out of symmetry the unbalanced pressure will tend to lightly mark the heavy printing type and deeply mark the small type. When stamping thermoplastics it is also necessary to consider the design of the moulding itself, because if there are any changes of section behind the area to be stamped which are likely to cause sinking, failure may occur on the stamping operation, the marking process not being able to accept more than a very small variation in flatness or thickness. When stamping onto the flat back of nameplates or into shallow recesses it is possible to use continuous ribbon foil. When marking deep areas it is first necessary to stamp out pieces of foil to the required shape, lay them in the recess and then perform the marking operation. In general this method of decoration is best confined to straight type stamping or to the colouring of background areas and it is not suitable for colouring the actual letters in a three-dimensional moulding. Recent developments in stamping dies, however, should increase the use of this process for decorating nameplates.

Silk-screen printing, frequently used on flat surface plastic mouldings, is also occasionally used for decorating nameplates. In this method the design is in the form of a stencil cut in the screen, the latter being fitted to a frame. The screen is applied to the surface to be decorated and the printing ink spread by means of a roller. Therefore, in decorating nameplates by this means it is necessary to confine it to the flat back or front surfaces or to ensure that any recesses are large enough to take a frame. This type of printing is particularly suitable for multi-colour work. As with paints, special inks are necessary that will give the required key to the plastic material. Close control of flatness and thickness of the moulding is not so necessary with this process as with hot stamping.

The last type of finish to be mentioned is electro-plating which although seldom employed, is capable of rather more application than it receives at present. The moulding must have the design raised and this is invariably on a front surface nameplate with the lettering and pattern proud at least 1/32 in. above the surrounding material. Small letters (say under 1/16 in.) or very close intricate patterns are unsuitable, since they will tend to become obscured under the thickness of the plating. While masking off certain areas is possible it is not generally practicable.

Design of Nameplates

Three-dimensional nameplates are usually moulded in clear material with the lettering and design recessed in the back, but they may also be front surface mouldings in opaque material with the letters and design raised above the general surface. However, since the majority of nameplates are of the former type and this style offers the most possibilities in design, most of the following remarks will apply to this type. The mouldings, in clear material, have the design recessed into the back, each part of the design often being cut to a different depth, while the front is usually smooth, although it



Moulding with design recessed into back and having front face decoration in addition.

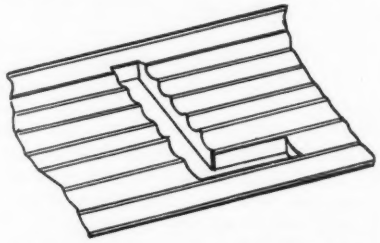
may be shaped in a curve or flat with rebated edges. Occasionally nameplates are made with both front and back surface decorations, but the main purpose of the smooth front face is ease of cleaning and prevention of dirt collection.

While it is perhaps general to make this type of nameplate as a separate moulding, it is possible to incorporate the three-dimensional detail as part of a larger component moulding. A good example of this is seen in refrigerator components. It is necessary, of course, that this component moulding be in clear material which is subsequently sprayed over the back to give an opaque colour.

In designing three-dimensional mouldings it is necessary to bear in mind the effect of looking through the thickness of the material at the design at the back. It will be found that the various heights of the letters and design appear as only two-thirds of their actual height, while the colours will tend to be slightly modified.

The form of engraved letters or decorative recesses also requires consideration in design. Deep thin letters are not particularly satisfactory for spraying and in general it can be taken that the letters should be at least as wide as they are deep, while with vacuum plating this proportion is the absolute minimum, since the coating will not consistently enter narrow depths. Any taper that can be given is desirable for ease of finishing and this again particularly applies to vacuum-plated finishes, since it is difficult to produce satisfactory plating on near vertical surfaces without considerable complication.

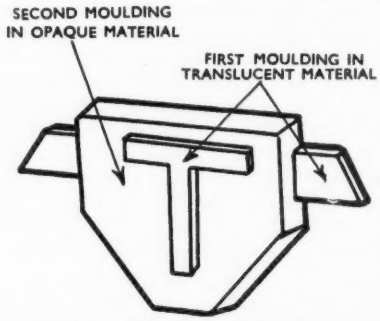
Vee sections of lettering are employed, but flat-topped letters are bolder in effect and, similarly, while script lettering is used it is not as effective as block capitals. Lettering or design that is narrow and shallow may conveniently be finished by wiping in paint and then cleaning off, which is a cheaper operation than spraying. In this case the letters or



Lettering recessed through a fluted background, the characters being decorated with one colour and the background with a second colour.

decoration should not exceed 1/16 in. in width and the surrounding area should be flat so that the excess paint can be readily cleaned off. Ample thickness of moulding should be provided above the recessed portions, at least twice the depth of the recess. This ensures stability of the moulding, freedom from sinking, sufficient strength and improved appearance.

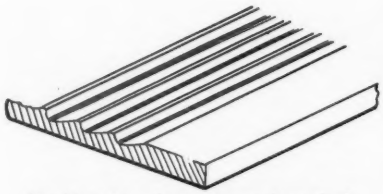
Many forms of moulded decoration are employed, one of the commonest being various forms and styles of fluting, these flutes invariably being sprayed all over in



Example of two-colour moulded pilot light emblem. The opaque is moulded integrally around the first moulding.

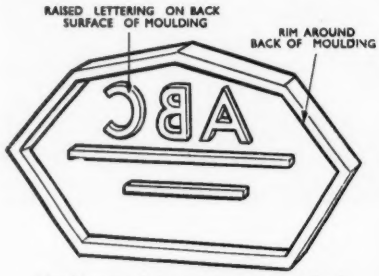
one colour. Other means are diamond facets, concentric grooves, and stippling. Beyond these geometric styles are various forms of pictorial insignia, such as heraldic designs, initials, trademarks or the stylized representation of objects.

Two further points are worth noting with respect to mouldings intended to be vacuum plated. First, areas of vacuum plating should be kept small—large portions of plating are apt to be loud in their effect and although vacuum plating is ideal for lettering or decoration, it is not suitable for extensive backgrounds. Secondly, the plating will show up any slight defects in the moulding in a marked manner—tool marks or blemishes—while slight unevenness in stippling or sand-blasting will throw up shadowed areas.



Moulding with design recessed into back, with front face decoration in addition.

A reversal of the recessed type of lettering can also be mentioned wherein the letters are raised on the back face instead of being recessed into the moulding. The three-dimensional effect is retained but tool costs tend to be reduced, while painting is also made easier since it is only necessary to paint the tops of the letters, although these will appear fully painted when viewed from the front.



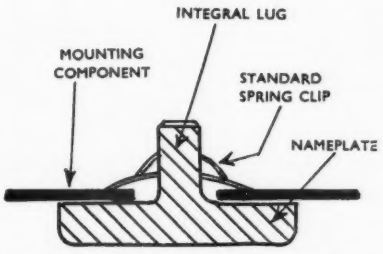
Moulding with lettering raised on back instead of being recessed. Tops of letters are usually coloured.

Raising a rim round the moulding will provide a flat back for fitting purposes.

Fastenings

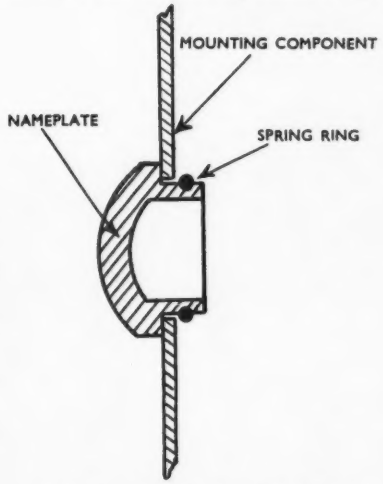
Always a problem with moulded nameplates is the securing of the plate to the component on which it is to be mounted. By far the easiest and cheapest method is to provide one or more fixing holes and to fasten the plate by means of screws, eyelets or rivets. With a fastening of clean design, plated and polished, the effect can add to the general appearance. Fastenings such as bolts or screws with specially designed heads can be used, but even standard plated items will be found attractive. If this type of mounting is to be employed, however, thought should be given to the holes in the moulding, since knit lines are likely to form if they are moulded. These are likely to show up if the background is painted a light colour, in which case it may be desirable to drill the holes.

The second common method of attachment is to raise moulded lugs from the back of the nameplate which will pass through suitable holes in the component. These lugs are then hot pointed over or secured by spring clips or any other suitable means. These lugs, however, will be visible from the front and must be accepted and incorporated in the general design, or alternatively the lugs and the area immediately surrounding their roots must be painted a dark colour. If this is done it will be found that they are no longer visible. A dark coloured panel or completely dark background is often employed and the lugs raised from this area. Round disc nameplates of the emblem type are often fastened by raising a central lug (which may be the sprue)



Fastening nameplates by means of moulded lugs.

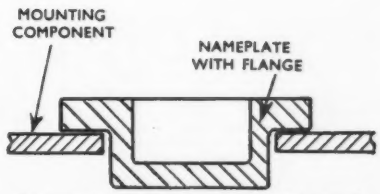
from the back and obscuring this, if necessary, by the same means. Alternatively this type of emblem can employ an annular rim raised from the rear of the moulding and slightly less than the diameter of the emblem itself. A hole of equivalent size to the outside diameter of the rim is then provided in the mounting component and the rim passed through it and secured in position by any



Fastening by means of spring ring let into moulded circumferential groove in moulding.

suitable means, such as a circular spring ring locating in a circumferential groove in the emblem rim. With these round types of nameplates the possibility of the plate turning should be kept in mind and it may be desirable to mould a locating key to prevent this.

A further method of mounting is to mould a flange round the back of the nameplate and to provide a suitably shaped hole in the mounting component

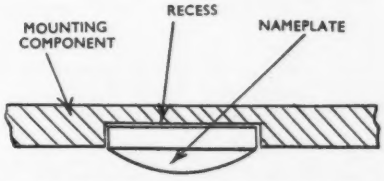


Fastening nameplates by means of internal flange.

equal in size to the actual nameplate (i.e. excluding the flange). The nameplate is then inserted through the hole from the inside so that the flange abuts against the inside surface of the mounting component. The flange can then be secured with cement, clips or other convenient means. The edges of the holes cut in the mounting component will, of course, be visible and in consequence it will be necessary for these to be presentable.

Adhesives are occasionally used to secure nameplates, but this method is not particularly to be recommended. If it is to be used it is desirable to sink the edges of the nameplate within a recess in the mounting component to prevent the edge being prised off. Acrylic material should be used in the moulding in preference to polystyrene, since the latter is much more susceptible to crazing and attack by cements.

A good, but more ambitious and expensive method of mounting is to employ a bezel or mounting clips of some type. These can be another moulding or



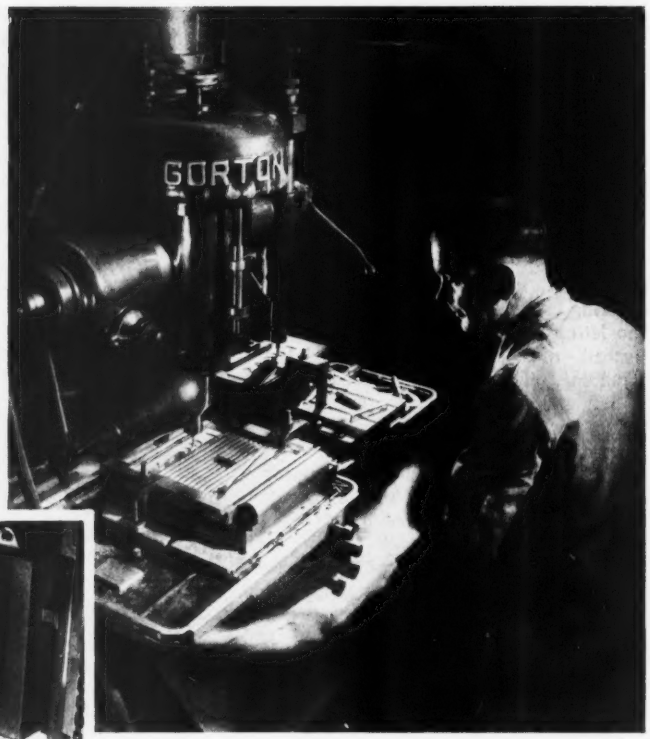
Nameplates which are to be fastened by means of an adhesive should be cemented into a recess in the mounting component.

of metal in the form of a sheet metal stamping or diecasting. The moulded bezel, which is in opaque material, has the advantage that the nameplate is freed from fastening lugs and is thus more easily painted, while the bezel itself provides a further decorative colour. Metal bezels can be plated and polished and can be fastened by a variety of means, such as tags that can be bent over, screwed inserts, or tapped holes.

There still remains a very considerable field of development in plastics nameplates. New styles of designing remain to be exploited, including the varying effects that can be obtained from combinations of colouring with the refractive properties of plastics mouldings. Plastics nameplates are now firmly established and continued development can confidently be expected.

MOULDING AND TOOLMAKING AT WITTON

Following a visit to the Witton Moulded Insulation Works of the General Electric Company, Ltd., by the editorial staff of *Plastics* to study the modern layout of this expanding plant, we have pleasure in publishing the photographs on this and the opposite page. Taken by Walter Nurnberg, F.I.B.P., F.B.P.S., they are excellent examples of the photographer's art, and show very clearly some of the important operations in the moulding of plastics. Although the Witton works were originally designed for the manufacture of electrical components in plastics for the company's own consumption, they have for long carried out work for customers, and employ most of the manufacturing methods current in the plastics industry today.



(*Above*) *A die-sinking and profiling machine accurately copies some lettering from a master plate on to a steel mould.*

(*Below*) *Milling the lower impression of a mould on one of the Keller automatic millers in the toolroom.*

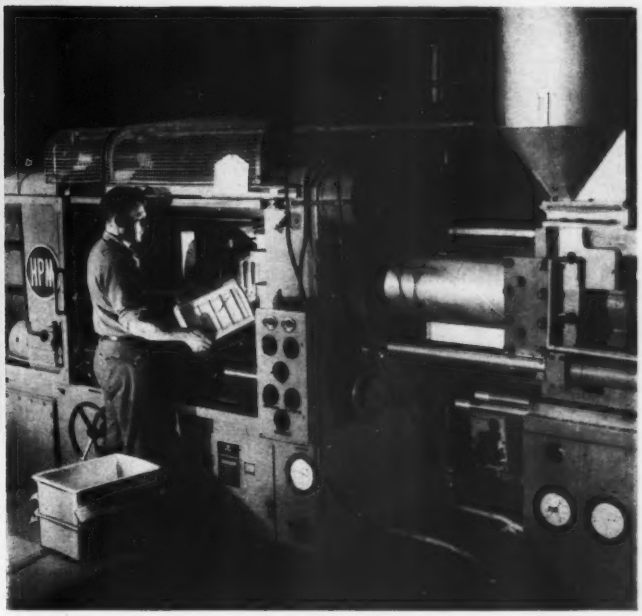
(*Above*) *Part of a mould assembly being heat-treated in a G.E.C. electric furnace. The selection of tool steels is of the greatest importance, for, besides the toughness necessary to resist the operating pressures, they must have a surface hardness sufficient to resist wear caused by the abrasive action of the flow of the material.*

(*Above*) *Compression moulding. A washing machine agitator, moulded from water- and chemical-resistant materials, is taken from the press.*

(*Below*) *Multiple moulding cuts costs. The press operator breaks down a sprue of eight polystyrene mouldings, produced in one moulding cycle on the small injection press in the background.*

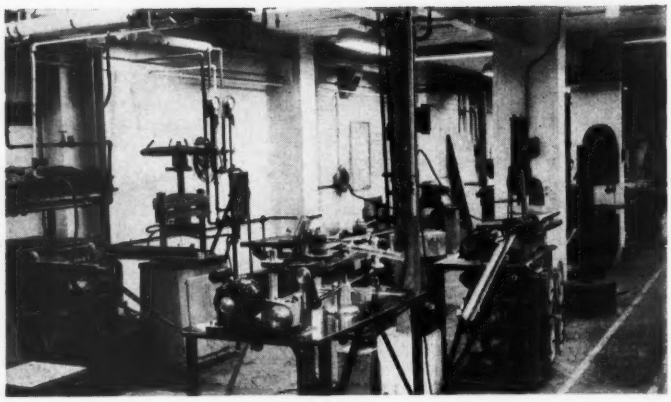
(*Above*) *Moulding in bituminous materials. A battery container for heavy vehicles emerges from the press.*

(*Below*) *The largest thermoplastic moulding produced at the Witton Moulded Insulation Works, a refrigerator tray. The photograph shows it being taken from a large injection moulding press.*



Technical Service to Customers

The rendering of technical services by chemical and plastics manufacturing companies has been a noteworthy feature of the second quarter of the 20th century. The understanding of raw materials by the user has been greatly facilitated and the difficulties of manufacture eased. The following notes describe one facet of the work of British Celanese Ltd. towards promoting such collaboration.



FEW will have realized that situated in the heart of London's West End is an elaborately equipped laboratory the sole purpose of which is to assist the customers of British Celanese, Ltd., who manufacture a range of thermoplastic materials which are sold under such registered trade marks as Celastoid, Cellastine, Clarifoil and Monoflex. The company has for a considerable time developed this aspect of service to customers, with the object of ironing out production difficulties and initiating new methods and apparatus. The laboratory has been responsible for a number of new techniques, some of which have achieved considerable importance in the plastics field.

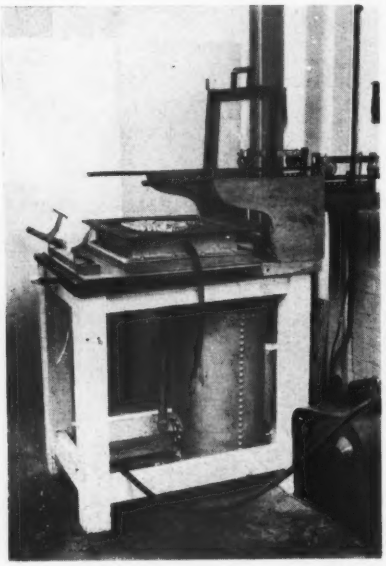
The measure of assistance given to any customer depends largely upon his previous experience in the sphere of plastics fabrication, and the size of the project in hand. Essentially, the laboratory would be doing a good job were it merely to offer advice; in fact, it frequently goes much farther than this, by showing customers, on the apparatus in Hanover Square, how various techniques can be effected. On occasion a prototype tool or machine is constructed, a good example of this being the fabrication of a display stand for a prominent polish manufacturer. During preliminary discussion, British Celanese decided to manufacture a tool from which sample mouldings could be obtained. So impressed was the client with the tool demonstrated that he employed it in his actual manufacture.

The laboratory is not concerned with the building of machines for production but only with the development of prototypes and of new materials and new products. Manufacturers may send their engineers down to study the apparatus there and copy or modify it for full-scale production if desired.

It would not be possible within the scope of a short article to describe all the apparatus which is available. It can, however, be said that the laboratory is a complete toolroom, as is demonstrated by the photographs which illustrate this article.

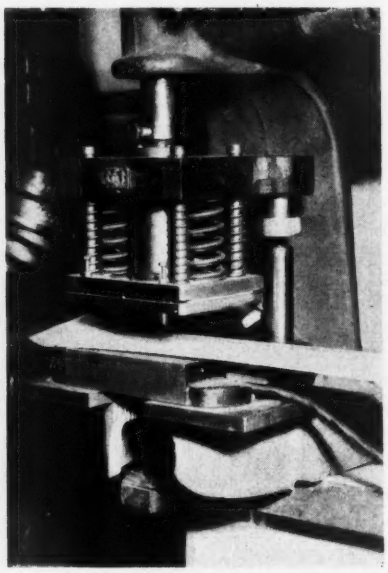
Perhaps the most interesting development during recent months has been the construction of a prototype vacuum-forming apparatus which can be made very cheaply and yet give remarkable moulding detail. Machines based on this prototype are now in the course of manufacture by Edwards (London) Ltd. and Pulsometer Ltd. The machines will be built to individual specifications up to maximum sheet area of 56 in. by 26 in. They will handle sheets of any colour from five thou. to 40 thou. thick. Such sheets can be silk-screen printed if desired before vacuum forming takes place. The moulds, which are also inexpensive, can be fabricated from cast aluminium, hardboard, plaster and wood; metal-sprayed shell moulds can also be used.

A special feature of this apparatus is that it can be fed from slit reel sheeting on a continuous basis, thus offering considerable advantages in speed of manufacture. The time cycle is roughly one second per one thou. thickness of material. A

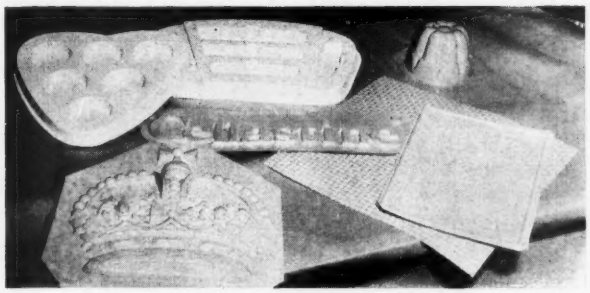


Prototype of vacuum-forming machine shortly to be commercially available.

Close-up machine's platen with mould in place.



Capping tool for continuous stamping of caps from slit sheet.



Examples of vacuum forming from acetate sheet.

panel heater is employed, of 2½ kW., giving a filament temperature of 750° C.

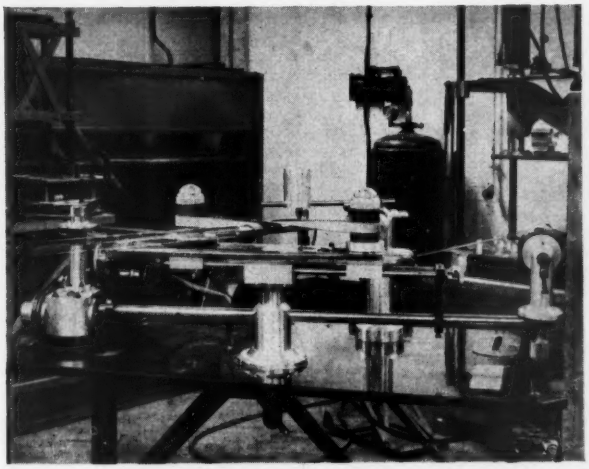
The capping tool which is shown was designed originally to give a low-cost, high-speed tool for the forming of caps from slit-reel sheeting. This technique has also the advantage that the use of blanks is avoided and thus the wastage of material is reduced to the minimum. Output is up to 1,000 units per hour, the die being cooled by an air ring. The pressure plate is kept at a temperature of 100° C. and the bottom plate die at 70° C.

Spiral winding is a method of fabricating tubes from ½- to 3-in. diameter depending upon the gauge of the material. The machine displayed, which is a modified prototype, is now being manufactured by R.B.K. Associates Ltd., and will produce up to 40 ft. of tube per minute.

Acetate monofilament has found considerable application in the spiral binding of books. In spirally winding monofilament for this purpose, the correct pitch is obtained by feeding to the rotating head of the machine a number of ends of the monofilament side by side. Heat is applied near the take on to soften the material and enable it to be formed into the desired spiral form and it is set in this form by a blast of cold air before leaving the machine. A unique feature of the equipment is the provision of means for uncoiling the multi-end spiral into individual spirals.

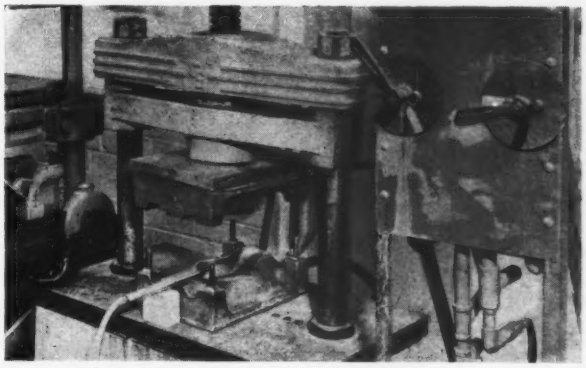
Sheet forming, probably the oldest technique for the manipulation of acetate sheet, is demonstrated by the simple apparatus illustrated. Laminated or wooden tools are used in conjunction with a spring-loaded pressure plate. Sheeting for this purpose is heated to approximately 250° F. in the infra-red oven.

Also shown on this page are photographs of equipment for the blowing of acetate, and the drawing of extruded acetate tube over wooden dowels, in this case a pram handle.

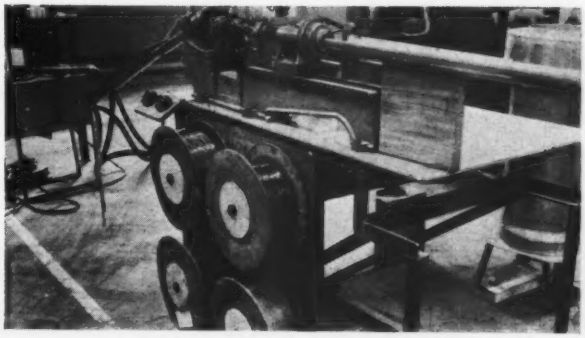


Fabricating tubes by the spiral winding technique.

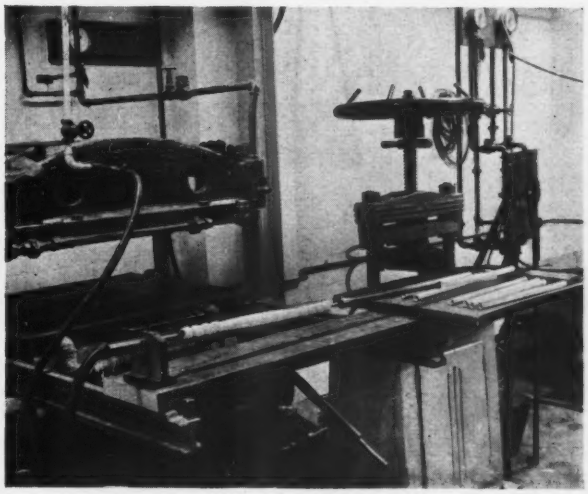
Apparatus for sheet-forming. Pre-heating oven in background.



Assembly for steam-blowing shoe display formers from extruded acetate tube.



Spiral winding acetate monofilament.

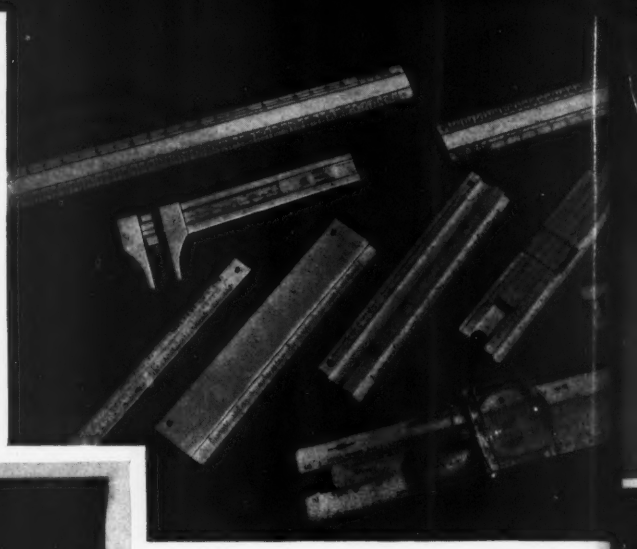


Drawing acetate tube over wooden dowels.

PLASTICS
IN THE SERVICE OF MAN

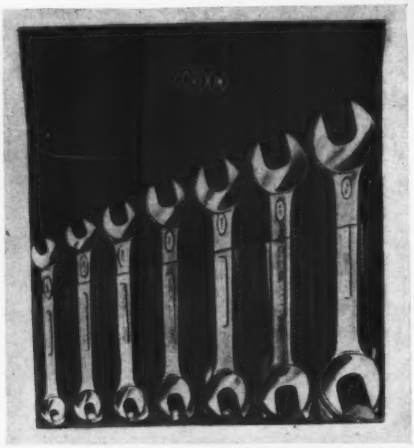
A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

45. Tools and Engineering Components—1

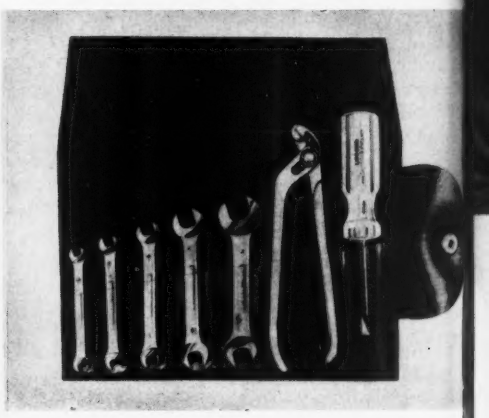


(Above) Scales, gauges, slide rules and drawing instruments are fabricated by Blundell Rules Ltd. from Perspex acrylic sheet. Unplasticized vinyl material is also used for this purpose. (Photo : I.C.I.)

(Above) "Eclipse" hacksaw frame handles moulded by Ashdowns Ltd., in blue cellulose acetate, for James Neil and Co., Ltd. (*Plastics*, 1951/July/190.)



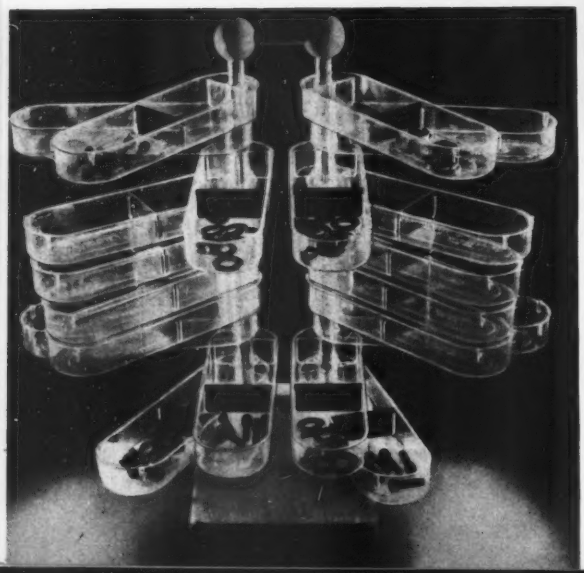
(Left and below) Tool kits manufactured by Gordon Tools Ltd., are packed in welded p.v.c. wallets produced by Acme Plastics Ltd.



(Right) The Spotlight screwdriver produced by Spot Tools (London) Ltd., throws light on the tip by means of an acrylic lens. (*Plastics*, 1952/April/105.)

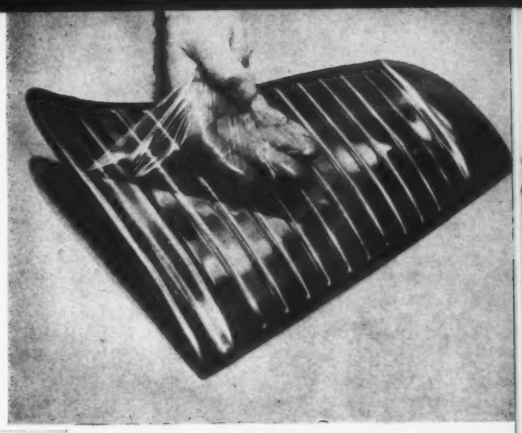
(Below) Visipart assembly trays, with individual trays moulded from transparent polystyrene, enable parts to be easily selected ; produced by British Central Electrical Co., Ltd. (*Plastics*, 1953/Oct./356.)

(Below) Tools cast from glass fibre/polyester resin dough are used by Bristol Aeroplane Co. Ltd., for beating of metal parts, resisting the high impacts used in metal work by hand or drop hammer. (*Plastics*, 1952/Nov./330.)

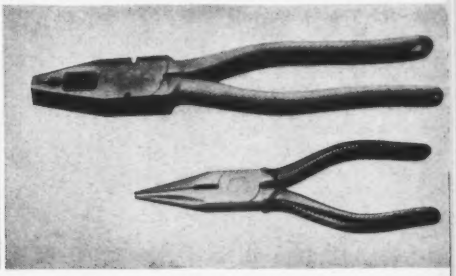


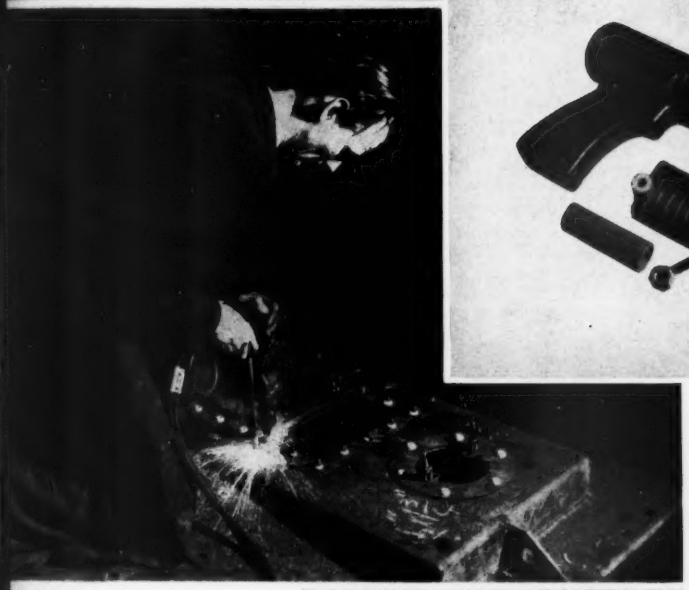
(Left) Pack for twist drills made by English Steel Corporation Ltd., has phenolic base and drill holder and transparent polystyrene cover moulded by Lorival Plastics.

(Right) A strippable coating of "Liquid Envelope" plastics film made by Jenson and Nicholson, Ltd., gives temporary protection to the surface of metal sheet during pressing operations.



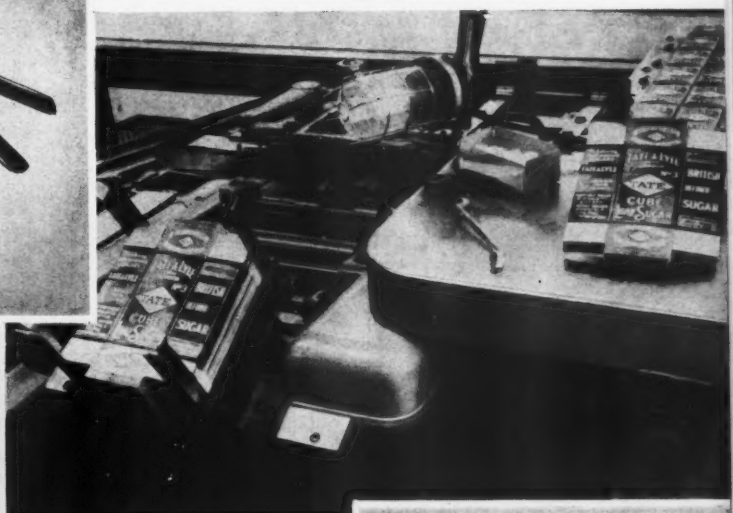
(Below) Electrician's pliers can be provided with hand grips sheathed with hard p.v.c., tested to 5,000 volts; produced by Creators, Ltd. (*Plastics*, 1949/Dec./138.)



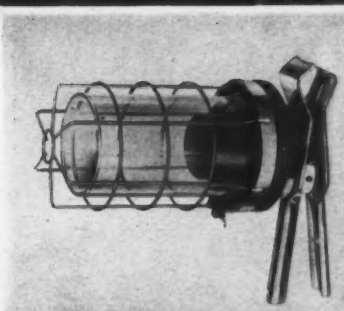


(Left and above left) The Nelson stud welding gun made by Crompton Parkinson Ltd. (seen here in operation), has a body moulded by Ashdowns, Ltd., from high-strength Bakelite phenolic material. Metal inserts moulded into the body are seen above, left. The moulding is produced unchanged since its introduction (see *Plastics*, 1949/Mar./120).

(Below and right) The "Super Gripper" safety inspection lamp made by the British Central Electrical Co. Ltd., has a plastics dome covering all live parts. The grip and the guard are made of reinforced shock resisting phenolic material.

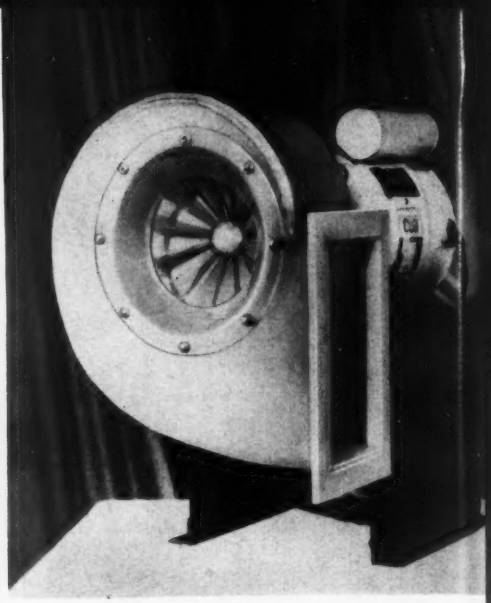


(Above and right) The shatterproof hand lamp with Perspex guard, made by the British Central Electrical Co. Ltd., is here seen in use at a Tate & Lyle Ltd. sugar refinery where contamination from broken glass must be avoided.



(Above) The strength, light weight and excellent optical properties of Perspex acrylic sheet make this material suitable for a variety of protective eye shields and goggles. (Photo : I.C.I.)

(Right) Turbro junior exhaust fan made by Turner and Brown, Ltd., with casing, impellor and impellor shaft fabricated from Vybak p.v.c. rigid sheet made by Bakelite, Ltd.

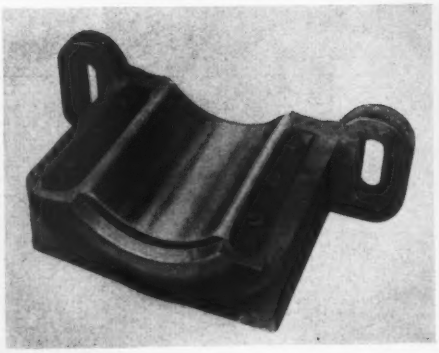


(Below) Cellulose acetate lever knob moulded by Rootes Mouldings, Ltd.

(Below) Nylon bearing bush for spindle of washing machine wringer, moulded by General Electric Co., Ltd., Witton.

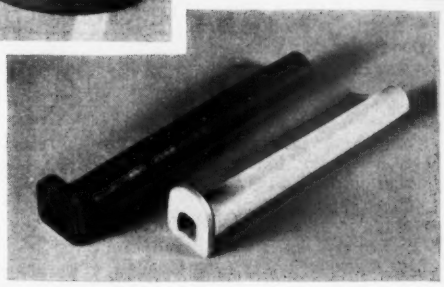
(Left) Ferobestos industrial laminates made by Ferodo, Ltd., are used in railways for buffer slide pads, various liners, pulley wheels and bushes, etc. (*Plastics*, 1952/Sept./262.)

(Below and right) Tufnol water lubricant bearings are seen below in service on a heavy steel rolling mill. The laminated bearing is shown assembled in its chuck (right). (Photos: Tufnol, Ltd.)

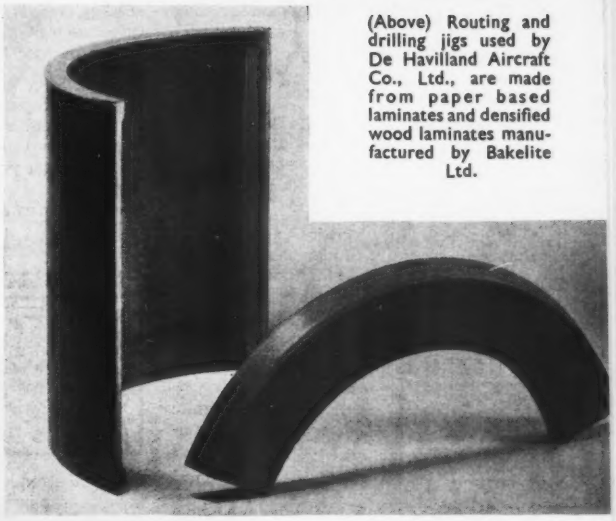


(Right) Railco phenolic resin-bonded laminates made by Small and Parkes, Ltd., are used in many industries as bearings, bushes, friction mountings, gears, etc.

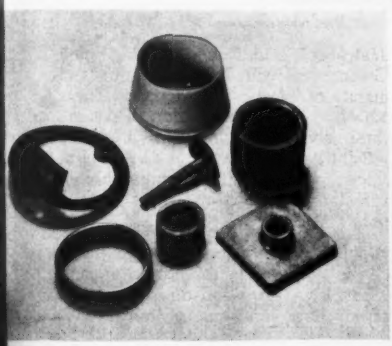
(Left) Bearings for rolling mills are manufactured by Ferodo Ltd., from Ferobestos asbestos reinforced phenolic material. Such bearings are used by leading steel companies in Great Britain.



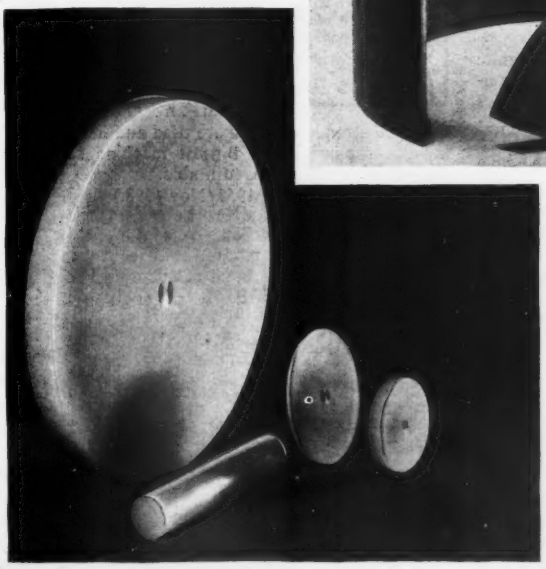
(Right) Injection-moulded insulating sheaths for plier handles are made in various colours by J. F. Kenure, Ltd.



(Above) Routing and drilling jigs used by De Havilland Aircraft Co., Ltd., are made from paper based laminates and densified wood laminates manufactured by Bakelite Ltd.



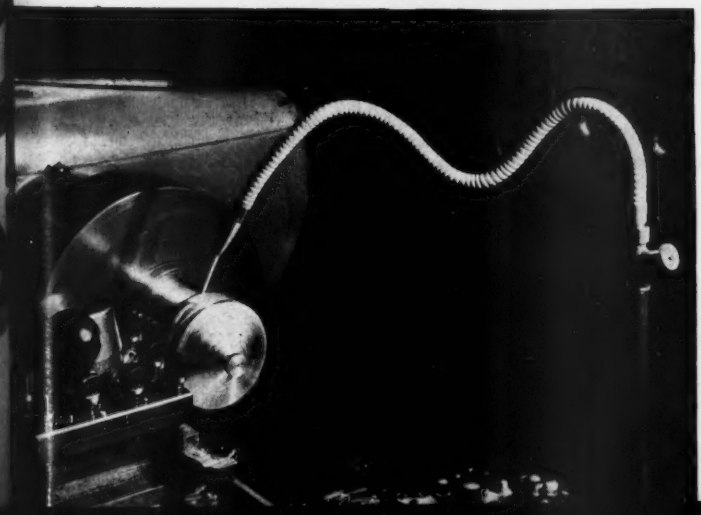
(Above) Flexible bushes, grommets and similar engineering components are injection-moulded from p.v.c. by J. F. Kenure, Ltd.



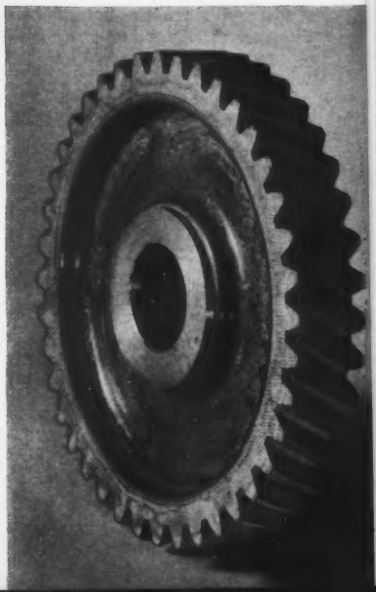
(Above) Laminated bearing liner and thrust collar, for use in hot rolling mills, made by the Bushing Co., Ltd., uses fabric incorporating special fillers for wear resistance. The liner shown is for a steel wire rolling mill with journal speed of 3,000 to 4,000 ft. per min.

(Left) Nylon blocks are injection-moulded by Fraser & Glass, Ltd., as blanks for machining gears, bushings and other components.

(Below) Rigiflex plastic pipe produced by Creators Ltd., can be maintained in any fixed position enabling a jet of coolant to be directed on to the cutting face of lathes, milling machines, etc.

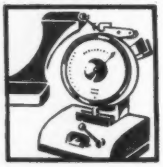


(Right) Texolex laminated fabric gear with metal insert moulded in position, having machine-cut teeth, produced by the Bushing Co., Ltd. for use on a Diesel jackshaft.



World's Industry Employs Plastics

MATERIALS and TESTING



New vinyl plasticizer. — Plastoflex MGB is a modified polypropylene glycol dibenzoate developed by Advanced Solvents and Chemical Corp., U.S.A. It is claimed to have low volatility and to exhibit strong solvent action for vinyl resins. The company says that test results with certain resins show greater tensile strength, higher modulus of elasticity and less odour than equivalent compositions plasticized with dioctyl phthalate.
(*Chemical and Engineering News*, 1953/August 31/3572.)

Properties and use of Teflon.—L. W. Cornell gives a general survey and discusses in particular the forms at present available and the methods of fabrication.
(*Mechanical Engineering*, 1953/Nov./883.)

Data sheets for plastics arranged in groups with generally similar characteristics, give a basis for broad preliminary evaluation of plastics for design purposes.
(*Machine Design*, 1953/Oct./170.)

INDUSTRIAL APPLICATIONS

A rotary hydraulic pump completely constructed of plastics has a two-piece Bakelite body and a flexible neoprene impeller giving a rated output of 3.41 g.p.m. at 1,000 r.p.m.
(*Machine Design*, 1953/Oct./199.)

Polyethylene pump impeller.—A chemical pump has been provided with an impeller of chlorinated polyethylene for pressures up to 150 p.s.i. and temperatures up to 160° F. The pump can be used for chemicals such as chlorine dioxide, chromic acid, nitric acid, sodium hypochloride, stannous chloride, sulphuric acid and pickling and electroplating solutions.
(*Products Finishing*, 1953/Dec./98.)

Plastics help mining industry.—L. A. Roe discusses present and possible future uses. Prominent uses at present: Safety helmets, miners' lamps, piping and fitting, mine plant models, rod and ball mill bearings, etc.
(*Engineering and Mining Journal*, 1953/Nov./88.)

Dipping basket.—An all-welded dipping basket, non-corrodible, has been produced of unplasticized polyvinyl chloride.
(*Products Finishing*, 1953/Dec./90.)

Moulded commutator assemblies of metal and plastic simplify production of small, intricate units and offer flexibility in design. The metal is blanked, formed and anchored to a plastic core.
(*Machine Design*, 1953/Oct./202.)

Silicone Putty.—Performance data and design features of new mechanical drives, i.e., slip clutches and couplings containing silicone putty. This is plastic and free flowing at low stresses, but shatters like glass with large and suddenly applied forces.
(*Product Engineering*, 1953/Oct./142.)

Plastics ball-bearing retainers are said to permit higher speeds. They are made from a variety of laminates by Synthane Corp., Oaks, Pa.
(*Product Engineering*, 1953/Oct./218.)

Laminates for cars.—W. G. Patton shows how glass-reinforced material speeds up the tooling programme of the 1954 American motorcar models. One major manufacturer is using glass cloth and resin laminate coated cast-iron welding and assembly fixtures.
(*Iron Age*, 1953/Aug. 6/136.)

Condensers of styroflex show high constancy of capacitance, low losses independent of frequency, high insulation power, low and negative temperature coefficient. The electrical properties are similar to mica insulators.
(*Oesterreichischer Maschinenmarkt*, 1953/Nov./349.)

PROCESSES : MACHINERY

Plastic preforming.—New technique by L. C. Williams and Ass. for plastic parts reinforced with glass fibres is similar to felt making methods. Chopped strands of fibres are used and hand lay up is eliminated. Biggest machine so far produced has 46-in. turntable.
(*Product Engineering*, 1953/Nov./198.)

Wire covering of Teflon.—A new method of applying Teflon (p.t.f.e.) to bare wire, known as three-dimensional calendering has been announced by E. I. du Pont de Nemours Inc.
(*Electronics*, 1953/Sept./304.)

COATINGS and ADHESIVES

Use of silicones in the surface treatment of metals.—F. Ohl deals with various applications of silicones, for instance, silicone oils to make surfaces on glass or ceramics hydrophobic, for preventing the formation of scum in solutions, preventing creeping currents. A further application is high-quality polishes using methyl silicon oils.
(*Metalloberflaeche*, 1953/Dec./A185.)

Design of glued joints.—S. Gunthorp shows how improved joint strength can be developed by adhesive bonding of metals.
(*Machine Design*, 1953/Oct./193.)

Pigmented phenolic resin finishes.—Two pigmented finishes have come on the market after extended tests; one produces a deep intense black colour, the other an even light grey finish which resembles aluminium surface coatings. Both products are said to be strongly resistant to corrosion.
(*Products Finishing*, 1953/Dec./76.)

Acid-proof coating.—Vinyl and butadiene-styrene resin coatings are intended primarily as acid-proof and alkali-proof maintenance paints in metal finishing, electrometallurgical and other plants using corrosive acids.
(*Wire and Wire Products*, 1953/Dec./1348.)

MISCELLANEOUS USES

Glass fibre laminations in a fishing cruiser.—An American firm covered the hull of a 31-ft. fishing cruiser with three laminations of fibre glass cloth and resin and also replaced the canvas on the deck and cabin top of a 32-ft. cruiser with a laminate consisting of one layer of cloth and three of resin.
(*Materials and Methods*, 1953/Oct./133.)

Efficient plastic scintillators.—L. Buch and R. K. Swank deal with the preparation and performance of plastic scintillators. These are synthesized by polymerization of styrene and vinyl styrene solutions of organic fluors. Scintillation decay time is 8×10^{-9} sec. or less, pulse height is comparable to that of fast organic crystals.
(*Nucleonics*, 1953/Nov./48.)

Vinyl-plastic laminate.—Marvinol-metal laminate is suggested for exterior and interior panelling, lawn and office furniture, business machine housings, chemical containers, etc.
(*Chemical Week*, 1953/Sept./66.)

Polymer Research.—I. Goodman reviews the development of polymer science and industry. Certain economic limitations are imposed on polymer production due to the scale of the industry.
(*Research*, 1953/Nov./425.)

Printed plastic legends.—Title blocks, bills of material, change blocks, technical symbols may be printed according to Johnson Research Corp., Bethpage, N.Y., on transparent seals for use on drawings and tracings.
(*Machine Design*, 1953/Nov./248.)

Plastics industry in Israel.—The Serafon factory which produces printed p.v.c. tablecloths and leather cloth has started to produce raw materials in a new polymerization plant with a capacity of 600 tons polystyrene moulding powder. It is intended to produce acrylics and polyvinyl acetate products. A condensation plant is intended to produce phenol-formaldehyde moulding powders.
(*Journal Assoc. Eng. and Arch. in Israel*, 1953/Sept.-Oct./421.)

A plastic tanker has been constructed of Laminac polyester resin and fibrous glass moulded in one piece. The 3,400-gallon tank has only a weight of 7,025 lb., i.e. 3,600 lb. less than a comparable steel tank.
(*McGraw Hill Digest*, 1953/Dec./44.)

EBONITE TODAY

By B. L. DAVIES, M.Sc., A.R.I.C., F.I.R.I.,
Senior lecturer, National College of Rubber Technology, London.

"FEW industries have grown so fast in recent years. In 1952 the production of plastic materials was six times greater than in 1938." So said the Parliamentary Secretary to the Board of Trade in a recent speech.

The picture so presented shows the position of the plastics family as a whole. It covers a reference period during which virile youngsters have grown almost out of recognition and in which several new members have been born. The period of 14 years is long enough for some of these newcomers to have passed through their teething troubles and to have started to grow apace. The war emergency included in the period provided conditions of exceptional need which were favourable for rapid development of the very young in a limited number of directions, and the period which followed has been, and still is, one of general growth.

In the midst of this activity the older members of the family tend to remain outside the limelight, their days of spectacular achievement having passed. Among these older members is ebonite, the oldest man-made thermoplastic. During the period in question ebonite celebrated its hundredth birthday and, to find that some of its former preserves have been, or are being, invaded by others is no matter for surprise. Such, indeed, is the story of ebonite for nearly a century.

Early Development

The credit for the discovery of the vulcanization of rubber goes to Charles Goodyear, but there is some doubt as to whether he first made ebonite. Thomas Hancock, in this country, discovered the master process using sulphur alone, and it is generally understood that he first produced ebonite, accidentally it is said, by leaving samples of rubber in his molten sulphur bath for long periods. He recorded in his B.P.9,952 of 1843 that in these circumstances the rubber "turns nearly black and has something of the appearance of horn and may be pared with a knife." Certainly Goodyear also made ebonite at about the same period. Thus ebonite antedates celluloid, often regarded as the first of the modern plastics, by some 20 years.

Hancock seems to have shown comparatively little interest in this rigid product and Goodyear displayed a much greater appreciation of its technical value. But the foundation of this section of the industry is mainly due to Nelson Goodyear, brother of Charles, who secured the first patent (U.S.P.8075), after legal controversy, in 1851. By that date a wide variety of articles had been made, and at the "Vulcanite Court" of the Great Exhibition were displayed tables and other articles of furniture, elaborately carved in the style of the Victorian period. Relatively little detailed information is available concerning this early period, but there is no doubt that some of the rubber companies of the time found ebonite manufacture a lucrative business. The Novelty Rubber Co. of America is reported to have made buttons, fancy boxes, canes and pipes so successfully that for some years their shareholders received 100% dividend!

During the latter half of last century the pneumatic tyre had not yet been developed and the industry, which now consumes well over half a million tons of rubber annually, was not even a dream; the rubber industry as a whole was still small. Of its production, ebonite goods represented a substantial and much more important part than it does today. Production figures were not officially recorded, but the 466 tons of ebonite goods exported from Germany in 1889 represents one-fifth of the total exports of rubber goods from that country. Such a figure is, perhaps, sufficiently indicative of the status of the ebonite industry relative to the whole rubber industry at a time when celluloid was a novelty and most of today's plastics were unknown except, perhaps, as chemical curiosities.

Twentieth Century Advances

The important advances both in scientific knowledge and in technical achievement which took place in the first quarter of the present century—the development of mechanical transport, generation of electricity and its use for lighting and power, and the rise of the modern chemical industry—helped and were helped by the new plastics, and also the older, well-tried materials, such as ebonite, bitumen and celluloid. The new devices demanded components made of materials more suitable than metal, wood and leather. Thus a lively actual and potential market was provided for the tiny infant plastics industry, and in the meantime ebonite was available immediately in the form of moulded insulators of many kinds, battery boxes, instrument panels, eyepieces, telephone parts, as tank linings, as a bonding material in the manufacture of solid rubber tyres and roller coverings, also as sheet, rod, strip and tube from which small parts, including fountain pens and pipe stems, were machined in considerable quantities.

Then came radiotelephony and in the late 1920s a minor boom was created by the demand for ebonite panels, control knobs and other parts for home and factory-built radio receivers. At about this period also, motorcars were becoming much more widely used and rapid increase occurred in the production of batteries for their ignition systems. Later the use of batteries was extended to starting and lighting purposes, involving large numbers of ebonite containers, covers, plate separators and sundry small fittings. The railways also changed from gas to electric lighting, and to this day railway coaches carry batteries housed in ebonite. Telephone exchanges also use large stationary storage batteries, many of which have ebonite tanks.

Industrial developments during the past 25 years have been instrumental in creating demand for such items as valve

Moulded, extruded and fabricated products in ebonite for a variety of industries. This selection includes rayon spinning rollers, nozzles and fittings, textile bobbins, a billiard pocket, flooring strip, channels and sections.
(Photo courtesy Lorival Plastics.)

seatings, clutch linings, water-meter components, refrigerator parts, bearings, acid pipes, fittings and pumps.

What of Today?

On a number of occasions within the past 20 years it has been asserted that the ebonite industry is suffering from senile decay. In 1939, for example, H. Barron stated that the newer plastics had already made large inroads into sales of ebonite, remarking that formerly "ebonite could laugh at bakelite as a competitor. Look at the position now." Today ebonite manufacture represents about 1% of the rubber industry and only a small percentage of the total output of manufactured goods by the plastics industry. Total annual tonnage from factories in the United Kingdom is of the order of 3,500 tons. It thus occupies a position of much less importance than formerly.

The widely held view that ebonite is being displaced by the newer plastics probably dates from about 25 years ago, when rigid plastics, notably the phenolic resins, first came before the public notice and so far rubberlike elastomers had not yet appeared. Thus it seemed that the new rigid plastics must necessarily replace older rigid material, such as ebonite. This, of course, has occurred and is still occurring. Accordingly, the market for decorative goods has been captured by the newer materials with their attractive colours, excellent finish and rapid production.

In more recent times some success has been achieved in making battery boxes in polyethylene, polystyrene, rigid p.v.c. and even nylon. Water-meter parts have been moulded in polystyrene. But so far these items have not met with general acceptance, although they are being used for special purposes. Battery-plate separators of p.v.c. are used extensively in Germany, and within the past two years have become more popular here. Acrylic dentures have supplanted vulcanite ones during the past 10 years or so. Some refrigerator parts formerly made of ebonite are now being produced in tough rubber or in plastic materials. It seems, therefore, that the attack on ebonite sales did not cease with the capture of the decorative goods trade, and that the outlook for ebonite is indeed gloomy.

Let us therefore accept Barron's invitation and "look at the position now" rather more closely. In doing so it is of interest to take Mr. Strauss's reference period mentioned at the beginning of this article. Unfortunately, figures for ebonite production such as would be desired for this purpose are not available, the sequence of records being broken by the late war period. However, records of rubber consumed in the manufacture of ebonite goods in the U.S.A. for a five-year pre-war period can be compared with similar figures relating to British manufacture during a five-year post-war period. They show (see table) that during both these periods there was steady expansion, judged on the basis of raw polymer consumed. The average annual growth of the British ebonite industry during the past five years amounts to about 6% of the 1947 figure, a rate of growth which is substantially the same as that of the whole general rubber goods industry (i.e., exclusive of the tyre industry which consumes more than half the raw rubber produced). Thus the figures indicate that the ebonite industry is far from moribund; indeed, a steady increase of 6% per annum may well be regarded as a sign of good health in an industry over 100 years old.

Water-meter parts moulded in ebonite.

TONS OF RUBBER (NATURAL AND SYNTHETIC)
used in the manufacture of ebonite goods.

Year	U.S.A.	U.K.
1933	1,166	—
1934	2,047	—
1935	2,038	—
1936	2,203	—
1937	2,484	—
1947	—	1,622
1948	—	1,815
1949	—	1,986
1950	—	2,282
1951	—	2,358

In spite of the fact that ebonite is apparently being supplanted by various other plastics, the industry is still growing. What is the explanation? It is clear that either (a) the battery boxes and other articles which are now being moulded in plastics are not displacing similar articles made of ebonite but are additional, or (b) that the ebonite industry is finding new outlets for its products at a rate which is more than sufficient to replace its lost markets. In fact, both these deductions are true today. Some markets *have* been lost, some new outlets *have* been found, and many of the items which at first sight appear to be displacements of ebonite are, in fact, supplementary. The battery-box trade provides a good example of the last-named state of affairs. Polystyrene and polyethylene boxes are used for special purposes where high strength permits thin walls, giving lightness and space conservation, such as are needed in aircraft and in portable batteries of some types. Both are more costly than ebonite but serve purposes for which ebonite was never used. Nylon, again, is expensive, and cell containers moulded in this material are used only in conjunction with nickel-iron plates immersed in potassium hydroxide for special purposes, mainly on the Continent. Among entirely new items developed during recent years may be mentioned ebonite printing plates. Here the plastic-elastic properties of ebonite are utilized inasmuch as in one set of circumstances the ebonite plate will take an impression for printing purposes and in other conditions the indentation can be removed by elastic recovery and the plate rendered fit for re-use.

It is also significant that some articles which were made in ebonite a century ago are still so made, in spite of competition. Among these are hair-combs, pen and pencil parts, pipe stems and knife handles.

Ebonite has been used for making boxes, tanks and tank linings, and other pieces of chemical plant for several decades and is still considered by many chemical engineers to be the most suitable material for some conditions, despite the claims of p.v.c., polyethylene, etc. It is interesting to try to discover the reasons why ebonite has more than maintained its position. The reasons may fairly be stated as (a) its combination of properties, both physical and chemical, render it eminently suitable for certain applications, notably those involving electrical insulation and/or corrosion resistance, coupled with

suitable mechanical characteristics, and (b) the costs of materials and production are such that it can withstand competition in appropriate cases.

Properties of Ebonite

Ebonite is manufactured by heating a mixture of rubber with rather less than half its weight of sulphur. Such a simple mixture gives properties of the following order of magnitude: Tension strength, 9,000 lb./sq. in.; elongation at break, 4-10%; Izod impact strength, 0.4-0.5 ft.-lb./$\frac{1}{2}$-in. square; heat distortion temperature, 60-65° C. Strength, machining properties, corrosion resistance and electrical characteristics are, in general, at their best in such material. In practice, however, additions are made when improved heat distortion temperature, stiffness or hardness or thermal conductivity is required, and when the fall of strength which accompanies such modifications can be tolerated. The addition of other substances can also have an important effect on cost, not only directly but also indirectly, inasmuch as processing may be greatly facilitated and rate of production increased.

In general, these facts were known to the earlier workers and, although the extent of the changes brought about by compounding is now known with greater precision and in much greater detail, commercial ebonite today does not differ substantially either in properties or in composition from that of half a century or more ago. The industry has not been indifferent and many attempts have been made to produce improvements, but these have led to nothing of an outstanding nature. In common with the main rubber industry, ebonite technologists now use organic accelerators, but in contrast with the effects in soft vulcanized rubber, these substances do not improve the physical properties of ebonite and are less active in accelerating vulcanization.

Within recent years synthetic elastomers of the butadiene-styrene, polychloroprene and butadiene-acrylonitrile types have come into use to a limited extent. Butadiene-styrene types were used perforce during the war years as the only available substitute for natural rubber, but the properties of the vulcanizates were not equal to those of the original type. Today these synthetic rubbers are improved and are still used extensively in America and Germany. In this country there is a limited consumption for a few special purposes, often in conjunction with natural rubber. Modern elastomers of this type offer certain processing features which are attractive.

Polychloroprenes are used mainly as a component of natural rubber mixes, although ebonite can be made from neoprene alone when compounded with sulphur. Vulcanization occurs less rapidly than with natural rubber stocks, a fact which probably accounts for the higher impact strength and greater flexibility achieved when a proportion of neoprene is blended with the natural rubber.

Acrylonitrile-type elastomers, when vulcanized with sulphur, yield hard products with higher heat distortion temperature and good strength. Such materials are, however, difficult to process. Plasticizers are needed to facilitate calendering, etc., with reasonable ease and such additions partly offset the enhanced mechanical properties associated with the polymer.

It may therefore be said that, although the use of synthetic rubbers offers potential improvement in quality, at the present stage of development these improvements are only partially achieved. The great bulk of the ebonite manufactured today is still basically vulcanized natural rubber.

Developments in Moulding

The developments in moulding equipment and technique which have taken place during the past 20 years or so are, of course, well known in the plastics industry as a whole and the ebonite section has kept abreast of the times.

Thirty years ago small repetition mouldings were made in cast-iron or mild-steel moulds which were manhandled in and out of simple presses, some of which were not even hydraulically operated. Cure times were long and to produce reasonable output from a given mould it was customary to " set-cure " the goods in the mould and complete the long cure by subsequent heating in a steam pan or oven. This technique gave poor finish and considerable dimensional variation due to distortion and variable shrinkage. Cures were normally carried out at about 140° C. and times were of the order of 2-4 hours. Other and larger moulds were held in the closed condition by means of bolts or clamps. The assembly was then heated by direct steam in a pressure vessel.

Between 1925 and 1930 organic accelerators became generally available and cure times were thereby shortened. But times were still very long compared with those of the new phenolic resins then just being produced in bulk in this country. There is no doubt that the advent of these resins stimulated ebonite manufacturers to consider their position and to learn the lessons taught them by the new moulding industry which was growing rapidly. Indeed, an attempt was made to " answer " the challenge by introducing the direct moulding of ebonite dust, but nothing more has been heard of this for many years.

During the past decades ebonite moulders have followed, and taken part in, the development of more refined moulding methods, and today these procedures are as " advanced " as those generally used in resin-moulding plants. Higher moulding temperatures have been found possible, thus reducing cure times, and further reductions have resulted from the conservation of heat in the moulds. First, by the use of fixed tools, large heat losses arising from withdrawal from the press were prevented and later came further economies by the use of auxiliary equipment to facilitate and accelerate charging and discharging. Transfer injection techniques, by utilizing frictional heat developed in the material itself, help to reduce cure times, and preheating devices have found some applications.

All these developments have had far-reaching effects, not the least of which is the modern tendency to cure ebonite goods completely in the mould. This has given a general improvement in quality which may be interpreted as (a) better finish from the mould; articles formerly machined or buff-polished can nowadays be produced direct; (b) greater accuracy of moulding and better thermal stability; (c) better mechanical and electrical properties, as compared with hot-air or steam-hardened mouldings. As an example of the order of reduction of cure time brought about by modern developments, the following may be quoted. In 1900 small surgical sundries were manufactured by the steam-pan procedure mentioned above, the time of cure being 9 hours at 140° C. Similar goods were made in 1925 using the press-plus-pan method in 5 hours. After the introduction of accelerators at about the same time, cures were complete in 2 hours. Nowadays small mouldings of similar type can be produced in high-temperature transfer moulds using preheated slugs in 6-8 minutes. It is remarkable that modern mixings for this purpose are not markedly different from the earlier ones, except for the use of organic accelerators. The most striking changes have been brought about by developments in moulds, presses and techniques.

There are few, if any, ebonite articles made in this country on a really large scale, but in countries where larger markets exist some instances of mass production are to be found. In Germany, the U.S.A. and elsewhere, for example, partially mechanized moulding plants are in operation, using cycles of the order of 8-10 minutes. Such production units are, of course, expensive to install and have become justified only by the elimination of unnecessary variations of design and dimensions and the acceptance by many consumers of a standard product. Much more has been done towards such standardization in Germany than in this country.

New Laboratories for I.C.I. at Welwyn

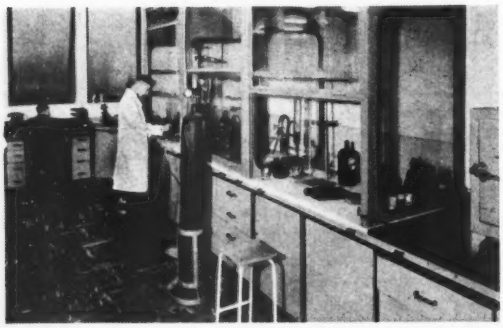
On January 5, Sir Cyril Hinshelwood, Lee Professor of Chemistry at Oxford, and Dr. Alexander Fleck, chairman of Imperial Chemical Industries, Ltd., opened what are said to be the first fully flexible laboratories in Great Britain. Plastics materials were widely employed in their construction. They will be used to extend I.C.I.'s field of research in physical chemistry.

THE Plastics Division of Imperial Chemical Industries, Ltd., has completed at Welwyn Garden City a novel three-storey research laboratory in the building of which plastics materials have played a very large part. The main object of the design has been to produce exceptional flexibility in internal arrangement. By means of standardized wall sections, laboratory equipment, plumbing and lighting it is possible with the minimum of trouble to alter entirely the layout of any one of the three floors. This means that the research worker can at any time arrange his part of the laboratory to fit in with his individual needs, instead of carrying out his research within the fixed limitations of a standard laboratory. Alterations which would normally necessitate major construction work are merely a " spanner and screwdriver " job in the new laboratories.

Basically, the laboratories consist of three unobstructed floors 176 ft. by 48 ft. Throughout, measurements are based on units of 4 ft. so that all wall panels, piping lengths, bench units, etc., are interchangeable. The main framework is of steel, cladded externally with plastic " Holoplast " panels. Holoplast is also used for the demountable partition walls and standardized doors, and for the bench tops, though here it is covered with wood veneer. The underbench furniture, cupboards and drawers are faced with Formica. The floors are tiled with a p.v.c. material, also used for demountable drainage pipes. Polythene is used for part of the plumbing, and the lighting fittings are of Perspex.

The new laboratories are part of I.C.I.'s programme of expansion of its already large research facilities. Every year, the company spends £7,500,000 on research and development which is carried out at research centres throughout the country. One result has been the introduction of a wide range of new and improved products, many of which have become household words. For example, Perspex—the acrylic plastic—was introduced commercially by I.C.I. Since its early days, when it was used for the transparent glazing of Allied aircraft, it has been developed until it appears now in hundreds of shapes and forms. Another outstanding product of I.C.I. research is polythene, a material which contributed very greatly to the success of another achievement of British research—radar—and which today is widely used for electrical insulation in television, telephony and all branches of electronics.

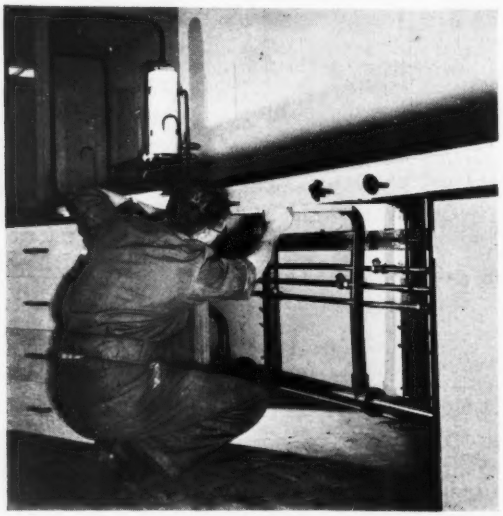
The plastics division of I.C.I. was formed in 1936, and its headquarters moved to Welwyn Garden City in 1940. Due to wartime and post-war restrictions on building, and the rapid overall expansion of the division, research has had to be carried on in improvized laboratories until the present day. In these new laboratories, the division is now fully equipped to tackle the diverse problems involved in plastics research.



(Left) Fume extraction units in one of the laboratories.

(Below, left) Corner of the spectrographic laboratory. Furniture faced with Formica, bench tops of Holoplast. Floors are of p.v.c.

(Below, right) Bench services facilitate speedy rearrangement of laboratory layouts. Drip wastes made of Alkathene, drainage pipes of rigid p.v.c.



LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Coating Paper and Plastics

SIR,—We should like to know if there exists a liquid plastic which could be used for the coating of paper or waxed paper forms. A transparent substance which could be coloured if required, and which would surface harden immediately after use. This need not be a high-grade material, and it would be an advantage if it were somewhat pliable when dry, although this is not entirely necessary.

At the same time, we require a hard finish, quick-drying, clear glaze, to be used for the purpose of finishing coloured plaster ornaments, in order to give a hard, glossy, durable surface, and wonder if there is anything in the plastics field which would be suitable for the purpose.

DAVID POTTS (BLACKBURN) AND CO.
71 Larkhill,
Blackburn, Lancs.

Extruded Roller Covers

SIR,—We are desirous of contacting a manufacturer who is producing, or can produce to order, slatted flexible roller-type covers in extruded plastic material. This venetian-blind-type shutter is required for proposed production of a new model of our portable electro-mechanical instrument.

ASSOCIATED CINE EQUIPMENTS, LTD.
353 Bexley Road,
North Heath,
Erith, Kent.

Plastic Bags

SIR,—We would be much obliged if you could inform us to whom we should apply in order to find a British firm who is interested to go in partnership with us for the manufacture of plain and printed Cellophane bags in Canada.

BEM COMPANY.
1231 St. Catherine West,
Montreal 25,
Canada.

Dart Flights

SIR,—Would you please let me have names and addresses of manufacturers of plastic dart flights.

G. D. BAINES.
Melbourne Street,
Old Road, Farsley,
Near Leeds.

Plastic Pipes

SIR,—We have been requested by our associates in British Guiana to obtain information for them on plastic pipe or tubing. We should be very glad if you could give us a list of people who may be able to help us in this matter.

ALUMINIUM UNION.
The Adelphi,
Strand, London, W.C.2.

The Use of Impregnated Fabrics

SIR,—Could you kindly assist us by letting us know some of the uses of cotton duck treated with phenolic resins and if anyone specializes in this material?

THE FLEET LEATHER MANUFACTURING CO., LTD.
Crossgar,
Belfast,
Northern Ireland.

Plastics Moulded Stereoscope

SIR,—A customer in Australia has sent us the following letter: "Recently we have been shown a sample of the View Master stereoscope manufactured by Sawyers Incorporated of Portland, U.S.A. This is a most interesting idea and consists of a small plastic box with eye pieces in which a disc about 3 in. to 4 in. is placed, each disc having seven colour transparencies of about 8 mill. size placed round the edge. By pressing a small lever the disc rotates and the person viewing sees a perfect three dimensional picture. It is possible to obtain views from all over the world by obtaining a supply of discs. We would be interested to know whether such a unit is available of British manufacture and if so, data on same. The overall size of this unit is only approximately 6 in. wide by 4 in. high by 5 in. from back to front of the eye-pieces. It would be very much appreciated if you could let us have any information available at your earliest convenience."

If you know of anyone in this country making anything similar, we should be much obliged if you would kindly tell us who they are.

W. A. SPARROW AND CO., LTD.
4-7 Chiswell Street,
London, E.C.1.

Buckets and Lined Drums

SIR,—Could you please give firms who manufacture plastic buckets (2½ gal., etc.) and steel drums containing p.v.c. linings.

Could you also inform me if any solvent exists which is capable of reducing scrap p.v.c. sheet to a semi-liquid suitable for use as a chemical-resistant "paint."

A. LANGTON.
Elmwood Green,
Leeds, 7.

The Extrusion of Plastics

SIR,—With reference to my article "Problems and Trends on Modern Screw Extruders for Thermoplastic Materials, in the December issue of *Plastics*, I should be glad if you would kindly arrange for the following correction to be published. Page 408, col. 2. For "Very often the speed of the screw and thus the output of the extruder is limited by the frictional heat, especially at the rear end of the screw where internal friction is reduced, external heat has to be applied to the material" read "Very often the speed of the screw and thus the output of the extruder is limited by the frictional heat, especially at the rear end of the screw where internal friction is at maximum, external cooling has to be applied to the material."

E. GASPAR,
The Projectile and Engineering Co., Ltd.
Acre Street,
London, S.W.8.

Vinyl-coated Plastic Sheeting

SIR,—We have received an inquiry for vinyl-coated plastic sheetings, which must not crack or break: they must have a certain tensile strength but must not be brittle, at the same time they must have a certain amount of elasticity. We should be pleased if you could give us the names and addresses of firms manufacturing such a sheet and also sources of supply for a press which would be capable of forming the sheet into any required pattern.

GOODE, DURRANT AND MURPHY, LTD.
197 Great Portland Street,
London, W.1.

Vapour Blasting

SIR,—We would be pleased to know the names of firms, preferably in the London area, who can undertake vapour blasting for us.

Should there be any interested firms we would be pleased to give them full details of the work involved.

LONDON AND SCANDINAVIAN METALLURGICAL CO., LTD.
Gonsalva Road,
London, S.W.8.

Tank Sealing

SIR,—Would you please recommend a material to use as insertion to water-proof a number of panels being bolted together to form a tank. We require material in strips one inch wide.

In the past we have used rubber, but we would imagine that one of the new plastic materials such as polythene, synthetic rubber, or other pliable material would be better suitable for immersion in water.

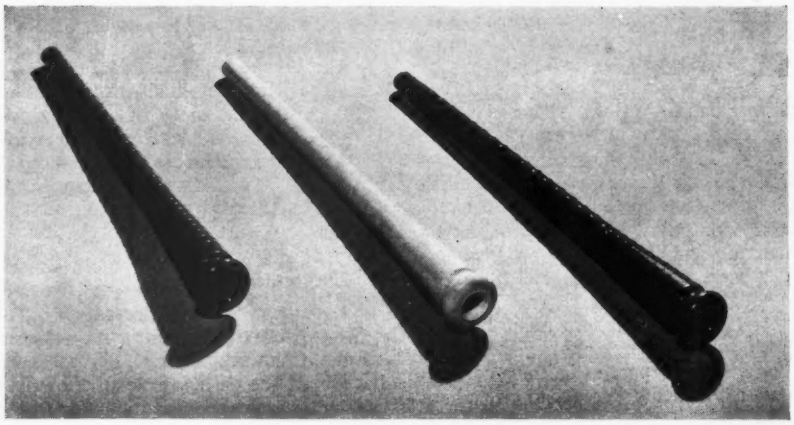
We shall be glad if you will put us in touch with a firm supplying suitable materials, which we should use in fairly substantial quantities.

B. B. KENT, LTD.
Ajax Works,
Ming Street,
London, E.14.

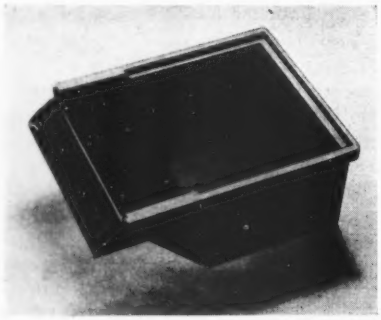
New Productions

Textile Pirns

A new range of plastic pirns for the textile industry is being moulded by Salon (Nelson), Ltd., Hollim Bank, Nelson, Lancs, in MHI grade of improved impact type polystyrene, manufactured by Erinoid Ltd., Stroud, Glos. The medium high impact grade polystyrene employed gives the pirns excellent dimensional stability and resistance to breakage or damage in use. A variety of colours provide means of distinguishing different pirns.



Textile pirns in high-impact polystyrene.



Kabi SB100 storage tray.

Bench Assembly and Storage Trays

The new Kabi SB100 storage bin has been designed to satisfy the demands for a larger container for storage purposes or for holding parts needed for assembly. It is moulded in brown phenolic material by Precision Components (Barnet), Ltd., 13 Byng Road, Barnet, Herts. The size, $7\frac{11}{16}$ in. long, $5\frac{1}{4}$ in. wide, $3\frac{1}{8}$ in. deep, is larger than previous assembly trays in the same series. The design is suitable for vertical stacking and the front lip of the tray is recessed for insertion of a label. The tray can also be produced in black, cream, red or green if required, colour difference providing a ready method of classification.

Pack for Dental Material

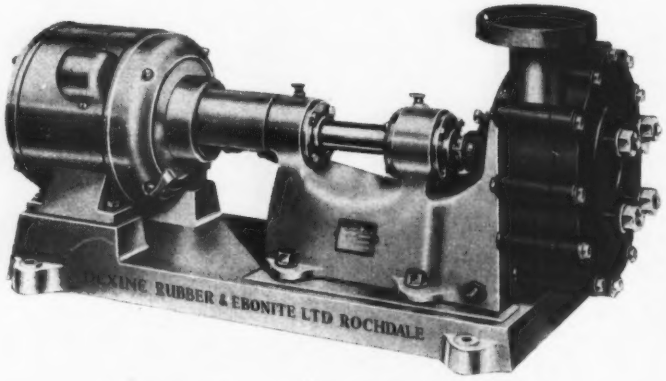
Zelex dental impression material produced by The Amalgamated Dental Company is now supplied in individual polythene bags in units which facilitate the rapid mixing of the components. The bags which are made from polythene lay-flat tubing have been produced by Cascelloid Ltd., Abbey Lane, Leicester. Two-colour printing directly on to the plastic material carries the trade mark and instructions for use.

Polythene bags for dental impression material.

Nasal Spray

A nasal spray produced by Bayer Products, Ltd., Kingsway, London, W.C.2, is being sold in a container designed and manufactured by the Industrial Applications Division of Cascelloid, Ltd. The container is manufactured from opaque white polythene with a textured finish, the name being embossed on the side. The cap is moulded in dark green polystyrene. It has a domed top with hexagonal sides to facilitate unscrewing.

Container for nasal spray.



Dexoplas chemically resistant centrifugal pump.

Centrifugal Pump

The Dexonite centrifugal pump has been moulded for some time by Dexine Rubber and Ebonite, Ltd., Rochdale, Lancs, from hard rubber. A new version employing the same design makes use of Dexoplas styrene copolymer material to give greater mechanical strength and chemical resistance. Unlike other modified styrenes Dexoplas is a thermosetting material which requires a "vulcanizing" process. The same material has also been extruded over mandrils to form strong chemically resistant pipes.

Food Mixer

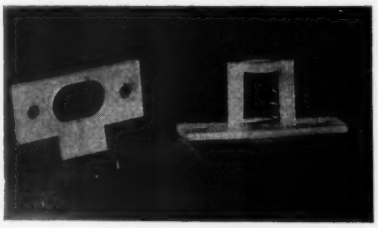
The Hydromix food mixer, produced in Switzerland by Artec, Grandson, is operated by a miniature Pelton turbine driven directly from the domestic water supply. The blades' rotation can be controlled from zero to a maximum of 10,000 r.p.m. at 3 atmospheres pressure. The body, base and the transparent lid, incorporating the turbine housing, are moulded in polystyrene. A clear plastic tube connects to the water supply. Three types of fitting adapt the mixer for cutting

Water-propelled food mixer.

vegetables and fruit, for mixing milk shakes, etc., or for whipping cream, eggs, etc.

Nylon Ball Catch

Moulded nylon components have in recent years found many applications in which their resistance to continual wear has been proved. A ball catch which has been developed by Universal Metal Products, Ltd., and which forms the subject of a patent application is moulded from this material. It consists of three moulded parts. The method of construction is simpler than conventional metal catches and the method of fixing is also very easy. Although it is intended to make a range of sizes, the first production is intended for cupboards, wardrobes and kitchen cabinets. Samples which have been subjected to tests by the manufacturers have withstood 100,000 operations without any signs of wear whatever.



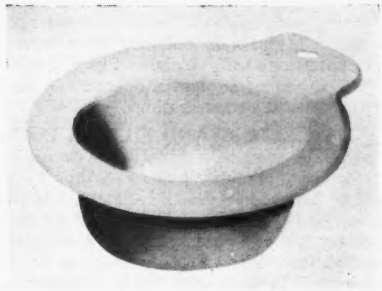
Nylon ball catch.

Polythene Condiment Set

A condiment set moulded in natural translucent polythene is manufactured by Bancroft and Partners, Ltd., 17 Victoria Street, London, S.W.1. The slight flexibility of the material enables the salt and pepper container to be used as a spray. The ribbed top is produced in different colours.

Polythene Infant's Pot

The popularity of polythene as a material for household articles has been established by the various makes of polythene washing bowls now on the market. The lightness, toughness and unbreakability of the material has also led to its use in buckets, dustpans, containers and babies' baths. E. K. Cole, Ltd., who last year introduced the baby's bath are now moulding an infant's chamber-pot. The "Plastapot" has a broad rim for the safe, easy seating of the child and a moulded-in tag enables the pot to be hung up. It is moulded in three colours—pink, blue and ivory polythene.



The "Plastapot."

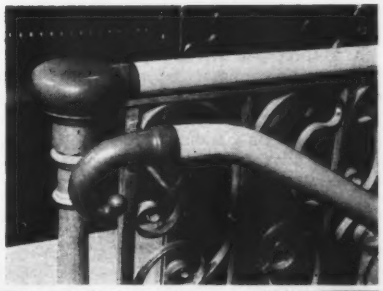
"Bird in the Cage" Toy

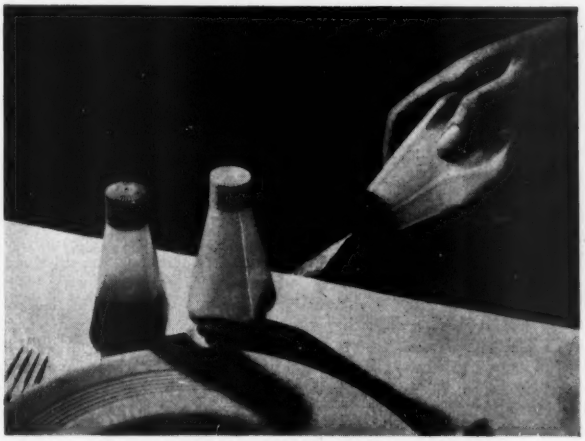
A novelty toy produced by Airfix Products Ltd., Haldane Place, Garratt Lane, London, S.W.18, is the bird in the cage which is moulded entirely from polystyrene. There are some 14 individual mouldings, the cage portion being a particularly fine example of tool-making.

"Bird in the cage" toy.

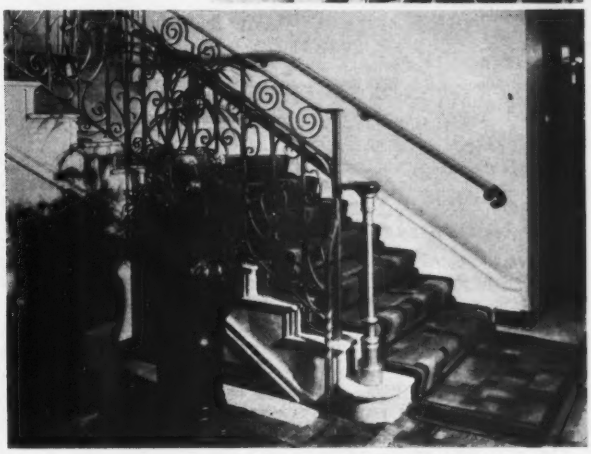
Stair Rails

Four years ago Creators, Ltd., of Sheerwater, Woking, Surrey, undertook the decoration and refitting of stair rails at The Strand Palace Hotel, London. The complete railings were dismantled and covered with extruded p.v.c. sleevings, 0.040 in. thick. This sleeving was supplied by BX Plastics, Ltd., Chingford, London, E.4. In addition, Creators, Ltd., made dip-moulded p.v.c. covers for the caps and ends of the rails. In view of the experimental nature of the installation, the work was not made public until it had been proved successful during four years of continuous use.





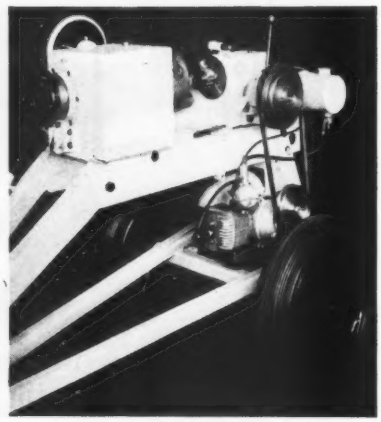
Polythene condiment set.



P.v.c.-covered stair rails with dip-moulded ends (above).

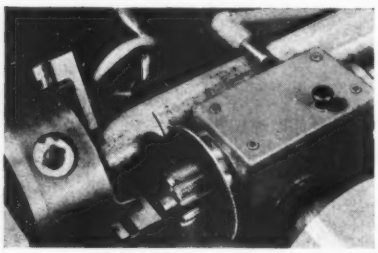
Plastics NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



Portable tube cutting machine.

TUBE CUTTING AND SCREWING MACHINES.—Marketed by J. C. Neville, Ltd., 34 Priest's Bridge, London, S.W.14, are the RG2 and RG4 cutting and screwing machines suitable for the fabrication of rigid and semi-rigid extruded plastics. The former is designed to deal with tubes from ⅛ to 2 in. diameter and the latter with tubes from ½ to 4 in. diameter. A low horse-power motor which can be connected if necessary to ordinary household lighting circuits, drives a saw and milling hob through a worm drive and vee belt. The pipe to be cut is screwed in a three-jaw self-centring chuck and at each end of the machine are supports which can be adjusted to steady the tube whilst being cut or screwed. The cutting spindle is mounted on a sliding saddle and in operation is advanced towards the pipe until it penetrates the wall thickness. The pipe is



Close-up of cutting head.

then rotated by turning the handwheel which operates the chuck; thus any desired length can be cut off. Lubrication during the cutting and screwing operation is supplied by means of an automatic suds pump connected to the hub of the motor drive. Average cutting times range from 10 sec. for ½ in. to 90 sec. for 4-in. tubes.

NEW RUMBLING MACHINE.—Designed for small quantities is the polymotion machine type "CAS" marketed by Fox Chemical Engineering Works, Ltd., Maybury Gardens, Willesden High Road, London, N.W.10. The barrel capacity is 1.1 cu. ft. and the overall dimensions, 2 ft. 5 in. wide, 3 ft. 6 in. high, 2 ft. deep. The barrel is rubber lined for the protection of delicate parts and is powered by a ¼ h.p. motor. As an accessory is a separating and screening machine, designed to separate work pieces from media after rumbling. Using ½ in. to 1½ in. screens it is possible to separate a full screen load in some 30 seconds.

RAYMOND SCREEN PULVERIZER.—Many synthetic resins can be pulverized with the aid of this machine, with outputs up to 2,400 lb. per hour, 90% of the material passing through a 100-mesh sieve. A small and compact unit, it is powered by a 7½ h.p. motor and runs at a speed of 3,600 r.p.m. Particulars can be obtained from Internal Combustion, Ltd., Woburn Place, London, W.C.1, and a test plant is operated at Derby for full-scale demonstrations.

TABLETTING AND FILLING EQUIPMENT.—We have received details of machinery manufactured by Arthur Colton and Co., 3400 East Lafayette Avenue, Detroit 7, Michigan, U.S.A. A series of rotary tabletting presses are described giving output speeds from 600 to 2,600 tablets per minute. Tablets up to 1¼ in. diameter can be produced on this equipment. A larger machine, having a slower output will yield tablets of 2 in. diameter; the unit develops a maximum pressure of 25,000 lb.

FACTORY EQUIPMENT EXHIBITION to be held at the Horticultural Halls, Westminster, London, from March 22 to 26, will feature mechanical-handling devices, packaging, storage, safety and welfare, and works office equipment. Over 100 exhibitors will be showing their products.

GAUGE AND TOOL EXHIBITION.—At the Exhibition to be held on May 17 to 28 at the New Horticultural Hall, several companies well known in the industry will be displaying their products. These include B.I.P. Tools, Ltd.; Plessey Co., Ltd.; Firth Brown Tools, Ltd.; Sigma Instrument Co., Ltd.; and the London and Scandinavian Metallurgical Co., Ltd.

R. H. COLE AND CO., LTD., inform us that they have been appointed distributors in the U.K. and Eire for the organic peroxides and per-acids manufactured by Elektrochemische Werke Munchen, Germany. Full details of these materials may be obtained from R. H. Cole, Ltd., at 2 Caxton Street, Westminster, London, S.W.1.

A.K.U. OBTAINS TERYLENE LICENCE. — N.V. A.K.U., Arnhem, Holland, have been licensed by I.C.I., Ltd., London, to produce Terylene fibres and yarns in Holland. A few months ago similar licences were granted by I.C.I. to French, Italian and German companies.

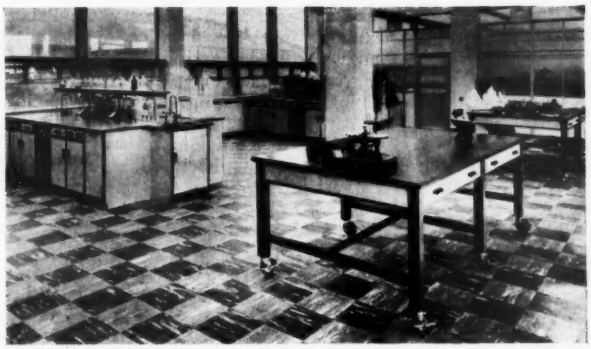
K. B. LENTIC, LTD.—For some time K.B. Products (Epsom), Ltd., and Lentic (England), Ltd., have been co-operating in the production of three-dimensional cameras and enlargers, etc., and the production of three-dimensional and change-picture show cards, calendars, greeting cards and novelties. As from October 1, 1953, an amalgamation of the two concerns has been effected under the name of K. B. Lentic, Ltd., with its head office at 97 East Street, Epsom, Surrey, telephone number Epsom 44045-6; and studios at 38 Bruton Place, London, W.1, telephone number Mayfair 1489.

PLASTICS INJECTORS, LTD.—A new company has been formed, with the above title, having its premises at 832 Green Lanes, Winchmore Hill, London, N.21; telephone number, Laburnham 5118. Mr. V. J. Breen, formerly with Lacrinoid Products, Ltd., is the managing director and we understand that the company, equipped with machines up to 6 oz. capacity, is concentrating mainly on the thermoplastics field.

CATALIN PRODUCTS, LTD., is the name of the newly formed subsidiary of Catalin, Ltd., now responsible for marketing all the products of Catalin, Ltd., other than industrial resins. The new company's offices are the same as those for the parent organization.

NEW BRITISH STANDARD.—Available from the British Standards Institution, 2 Park Street, London, W.1, price 2s. 6d., is a new standard B.S.2076:1954, entitled Thermosetting Synthetic-resin Bonded-paper Insulating Sheets for Use at Radio Frequencies.

REINFORCED PLASTICS CONFERENCE.—A private conference for the exchange of information on reinforced plastics was held by the British Plastics Federation at the Shakespeare Hotel, Stratford-on-Avon, from January 6 to 8. The conference arose out of the recent formation by the Federation of the Asbestos and Glass-fibre Reinforced Plastics Technical Committee. This was the committee's first conference. Only members of the Federation attended but experts came by special invitation from the Admiralty, the Ministry of Supply, the Royal Aircraft Establishment, Christchurch. There was a total attendance of 100, including representatives of 33 firms engaged in the manufacture of resins, laminates, reinforcement, plant and components. Informal papers were read and discussed, speakers being asked to disclose the nature of their research and development work and to discuss their current problems. The proceedings were strictly private and no record was made of what was said. Mr. H. A. Collinson, chairman of the Main Technical Committee of the Federation, presided. In a statement afterwards he said: "I doubt whether there has ever been in any industry such a frank exchange of confidential information as we have had in these past two days, both in session and in conversation." The Committee unanimously resolved to hold further conferences at intervals not yet decided and there was a strong feeling that it was desirable that all interests, including users, should be present.



Metallurgical laboratory in new research block of C. A. Parsons, Newcastle-on-Tyne. Work benches, constructed by Gallenkamps Ltd., are panelled in Warerite laminated materials.

WORSHIPFUL COMPANY OF HORNERS.—The annual plastics lecture and dinner of the Company was held at Fishmonger's Hall in the City of London on January 21. Mr. Norman Robertson, deputy managing director of E. K. Cole, Ltd., delivered the lecture. To mark the occasion he was presented by the chairman with a suitably inscribed book on London's Livery Companies. The Horners' Award for the design of an article made of plastics was presented to Mr. J. D. Vale of British Industrial Plastics, Ltd.

DISTRENE POLYSTYRENE INJECTION MOULDING MATERIALS.—British Resin Products, Ltd., have introduced a new grade of Distrene and are now offering Distrene 100X as a single general-purpose material replacing both Distrene 80 and Distrene 200 XL. The new material is for general-purpose injection moulding with good mechanical properties. It retains most of the heat resistance of 200 XL combined with the excellent transparency of 80. In moulding, it may require slightly less injection pressure than 200 XL An additional grade, Distrene 100, is offered for industrial applications requiring higher heat resistance and strength. These changes in no way affect the supply of Distrene 500 and 400, the high-impact and medium-impact grades respectively.

AID TO PACKAGING.—Offered at one-third the cost of previous precision types, Granby Metal Products, Ltd., announce a simply operated folding box constructed of plywood panels, having special zinc-plated steel strips riveted to its edge. All containers are manufactured to customers' sizes but are not recommended for dimensions over 2 ft. 6 in. It is claimed that the cartons will last for a minimum of 20 journeys and have an expected life, under normal conditions, of over 40 journeys.

NEWS OF AMERICAN PRODUCTION.—A bulletin from the Society of the Plastics Industry Inc., New York, reports a new record in materials production for 1953. At 3 billion lb. of synthetic resins it was 30% above the figure for 1952 and nearly five times the figure for 1943.

In a survey of sales statistics covering a representative group of 133 moulder members of the S.P.I., it was found that the gross sales of these companies for the first 10 months of 1953 were up 34% for the same period of the year before. Breakdown of sales for 1953 is as follows: thermosetting mouldings, $84 million; thermoplastic mouldings, $109 million; extrusions, $18 million. This last-mentioned item is nearly $3 million more than for 1952.

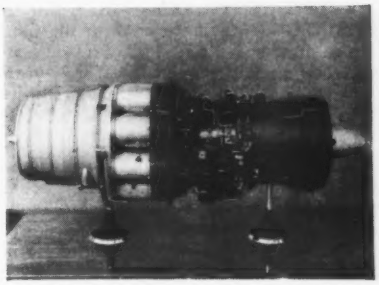
FIRE RISKS.—Recently published by the Fire Protection Association, 15 Queen Street, London, E.C.4, is Bulletin No. 20, dealing with fire risks encountered in the fabrication of plastics. This booklet, which will be of the greatest value to all concerned with the manipulation of plastics materials, gives information on the assessment of fire risk, in the case of each of the important plastics, information on fire fighting and refers to available publications dealing with this subject. Copies of the pamphlet are available from the Association free of charge.

FIRE AT RELIANCE ELECTRICAL WIRE CO., LTD.—Despite the outbreak of fire which occurred on the night of Saturday, January 9, swift action by the fire brigade and an emergency squad recruited from the staff resulted in the factory opening on the Monday afterwards under almost normal conditions.

BRITISH ARTID PLASTICS, LTD., EXPANSION.—A report from Mr. J. R. Severn mentions the company is now constructing a new factory, the result of which will be to increase the factory space by 50%.

Epoxide laminate car body, built by Mr. Marmion of Shell Chemicals Ltd. It is constructed from glass cloth laminates bonded with Shell's Epikote 828 epoxide type resin, using a wet lay-up technique with beaten aluminium moulds.

FIFTH CANADIAN HIGH POLYMER FORUM.—The 5th meeting was held at the London Public Library and Art Museum, Ontario, on November 19 and 20. Over 80 scientists and technologists attended, to hear 23 papers on all phases of high polymer chemistry. The following is an abstract of a paper read by A. D. Macallum entitled Phenylene Monosulphide Copolymer Resins. These resins are of a number of types, the physical properties of which vary with molecular weight and monomer composition. They are variants of the simpler p-phenylene monosulphide polymers in that they comprise some polyvalent benzene sulphide nuclei as well as the divalent phenylene sulphide group $-C_6H_4S-$. They are made from chlorinated benzene compounds by dry fusion with alkali or alkaline earth metal sulphides in presence of some free sulphur, best at about 300° C. So far most attention has been paid to the preparation and properties of a rigid resin type, a phenylene sulphide copolymer resin obtained from mixtures of p-dichlorobenzene and trichlorobenzene by fusion with sodium carbonate and sulphur (rather than preformed sodium sulphide).



Avon jet aircraft engine. Model fabricated in Perspex.

SHAWCRAFT MODELS, Bathurst Walk, Iver, Bucks, specialists in Perspex modelling have produced this excellent replica of a jet engine.

OMNI, LTD.—This company's new address is 35 Dover Street, London, W.1, telephone, Hyde Park 9451/5.

HESS PRODUCTS, LTD., have opened a London office at 11a Curzon Street, London, W.1, telephone, GROsvenor 7382.

CREATORS, LTD., have moved their factory and offices to Woking. The new address is Plansel Works, Sheerwater, Woking, Surrey, telephone, Woking 3971.

J. J. WADE (LONDON), LTD.—In the article " Polythene Pipes for Fire Service and Emergency Water Supplies " which appeared in *Plastics*, January, 1954, page 18, the above company was incorrectly referred to as J. J. Wade and Co., Ltd.

MICANITE AND INSULATORS LONG-SERVICE ASSOCIATION.—Miss Harriet Fletcher and Mr. Arthur Bull, employees of the Micanite and Insulators Co., Ltd., have recently completed 50 years' continuous service with the company. Miss Harriet Fletcher, who joined the staff in May, 1903, retired on December 31, 1953. Mr. Bull, who commenced work on January 1, 1904, is still with the company.

THE CITY AND GUILDS EXAMINATION RESULTS.—The following candidates were successful in the examinations held in 1953:—Intermediate Examination: K. Allcock, R. Bailey, A. G. Baker, M. A. Bardsley, L. Bridge, J. Buckingham, S. R. Cunliffe, G. B. Darby, D. C. E. Hickman, D. J. Higgs, A. W. Long, D. W. Massey, A. J. Newnes, N. B. Nicklin, H. Pyszora, E. J. Rollins, J. H. W. Rosindale, F. Williams, R. Willis. Intermediate, Material and Processes Paper Examination: R. Cummings, R. Hewitt, H. V. Reynolds, J. Townsend. Final Examination: S. C. Blunt, M. J. Cawkwell, J. J. Clarke, A. J. Freeman, R. W. M. Gillings, H. R. Glendinning, A. G. Gray, J. B. Hangar, R. J. Herbert, F. W. L. Hill, P. G. Lees, A. J. Lovett, H. R. Saville, E. I. Smith, J. B. Smith. Final, Materials and Processes Examination: A. Bonnici, L. Bridge, J. H. W. Rosindale. Final, Plant and Equipment Examination: D. Inman.

MR. L. A. BUCKLEY has been appointed Midland sales representative for Reliance Electrical Wire Co., Ltd. His address is 315 Lichfield Road, Four Oaks, Sutton Coldfield, Birmingham, telephone number Four Oaks 30.

RETIREMENT OF MR. B. A. ROBINSON.—Having been with the Cambridge Instrument Co., Ltd., for 41 years, and their district representative for 32 years, Mr. Robinson has now retired. He has been succeeded as district representative by his son, Mr. W. E. Robinson.

THE PLESSEY CO., LTD., announce that Mr. John A. Clark and Mr. Michael W. Clark have been appointed directors of the company. Mr. J. A. Smith, formerly a director, has retired from this office owing to ill-health. It is also announced that Mr. W. F. Cross has been appointed joint secretary of the company with Mr. E. H. Ouston.

NEW APPOINTMENT AT DAVID BRIDGE AND CO., LTD.—Mr. F. A. Fawcett, who was for 29 years in the marine and special contracts department of Metropolitan-Vickers Electrical Co., Ltd., has been appointed sales and commercial manager of David Bridge and Co., Ltd.

Mr. E. L. Tuff.

PROJECTILE AND ENGINEERING CO., LTD.—Mr. E. L. Tuff, M.I.P.E., works manager of the company, has been appointed a director.

Mr. J. G. Fraser.

NEW SECRETARY FOR TUFNOL, LTD.—Mr. J. G. Fraser has been appointed secretary to George Ellison, Ltd., and the associated companies, Tufnol, Ltd., and Alfred Ellison, Ltd. He succeeds Mr. R. Sawyer, who retires after 42 years' service.

TRIPLE CROWN.—At the Worshipful Company of Horners' Annual Plastics Lecture and Dinner, held at Fishmongers' Hall on January 21, the first prize in their annual competition for a plastics design was, for the third year running, handed to a member of the B.I.P. Product Design Service. A design for "an article made wholly or mainly in plastics" was called for in the 1953 competition, the judges placing special importance on new techniques, developments and applications in plastics. The winning design, a pair of heated shoe-driers, was submitted by John D. Vale of the Product Design Service of British Industrial Plastics, Ltd. It exploited the possibility of embedding low wattage electric elements between sheets of glass fibre impregnated with polyester resin.

NEW DIRECTOR FOR DERWENT PLASTICS, LTD.—Mr. R. M. Monks, sales manager since 1946, has been appointed to the board of the company.

Obituary

William Adam was born in Dumbarton, Scotland, in the year 1873, and died on January 2, 1954, at Bournemouth, England. (A brief announcement appeared in the January issue of *Plastics*.)

He was educated at Dumbarton Academy and Glasgow High School. On leaving school he became apprenticed to a banker's agent in his home town of Dumbarton. During the 1914-18 war he served in the Royal Flying Corps, later the Royal Air Force, as an engineer officer, but did not leave Britain. He then went into partnership in a firm of manufacturers' agents handling early gas-filled electric lamps and a patent make of puncture-proof inner tube for motorcars. After various other jobs he joined James Ferguson and Sons, Ltd., as a special sales representative for moulded rubber goods. He visited Germany and Sweden for this firm and was later appointed works manager of the reclaimed rubber and ebonite departments.

He subsequently became a director of Sicaloid, Ltd., importers of French casein materials and, as a side line, had manufactured and sold a car accessory, the Pukka extra air inlet, an invention of his own, and a petrol additive called Decarbonizers. He ventured into the plastics industry by joining the firm of F. A. Hughes and Co., Ltd., with whom he continued until he retired in 1948. In this capacity he was well known and well beloved throughout the plastics industry.

In his early days he was a track racing cyclist and won many cups, trophies and prizes. He was known as Adam of the Vale (The Vale of Leven, Dunbartonshire). He also was a cross-country runner and in his later years a keen tennis player. As a motorist he started with the early motor bicycles and finally a motorcar.

MEETINGS

February

15th.—"Terylene," E. D. Kamm, Ph.D., B.Sc., F.R.I.C. Plastics Institute, London Section, Waldorf Hotel, Aldwych, London, W.C.2. 6.30 p.m.

17th.—"The Use of Radio-Chemical Methods in Analysis," A. A. Smales, B.Sc., F.R.I.C., of A.E.R.E., Harwell. Plastics Institute, Western Section, The Technical College, Gloucester. Joint meeting with local branches of the Chemical Societies. 7.15 p.m.

17th.—"Fine Art Fakes and Forgeries," Prof. P. D. Ritchie, B.Sc., Ph.D., F.R.I.C. Plastics Institute, Scottish Section, North British Station Hotel. 7.30 p.m.

18th.—"Glass Fibre Laminates," Ashdowns, Ltd. Plastics Institute, North-Eastern Section, The Neville Hall, Newcastle upon Tyne. 7.0 p.m.

19th.—"Some Aspects of Colouring Plastics," C. Musgrave, Assoc. M.C.T. Plastics Institute, Midland Section, Birmingham.

26th.—"Recent Developments in Polystyrene," R. N. Haward, B.A., Ph.D. Plastics Institute, North-Western Section, Engineers' Club, Albert Square, Manchester. 6.30 p.m.

March

2nd.—"Design Aspects of Vinyl Chloride Manufacture," A. H. Goodliffe and Ir Noorduyn. Institution of Chemical Engineers, Geological Society, Burlington House, London, W.1. 5.30 p.m.

3rd.—"A Century of Ion Exchange," E. I. Akeroyd, B.A., M.Sc., Ph.D. The Royal Institute of Chemistry, London Section, West Ham Municipal College, Romford Road, E.15. 6.30-7.0 p.m.

8th.—"Some Aspects of Thermoplastics Injection Moulds and Moulding," A. G. Elwell. Plastics Institute, Midland Section, Leicester.

10th.—Film Evening. Plastics Institute, Yorkshire Section, St. Mark's House, 186 Woodhouse Lane, Leeds, 2. 7.0 p.m.

10th.—"The Effect of High-Energy Radiation on Plastics and Rubber," Dr. A. Charlesby. Plastics Institute, Southern Section, Polygon Hotel, Southampton. Joint meeting with I.R.I.

10th.—Film Show—"The Story of Formica"; "The Extraction of Penicillin"; "Bridging the Golden Gate." Plastics Institute, South Wales and Monmouthshire Section.

TALKING SHOP . . .

Vacuum Forming. The vacuum forming technique seems to have come to the fore in recent months, and I have now examined several examples of products fabricated in this way, as well as two machines specifically designed for this technique. It is apparent that with the progressive improvement in machine design, and with a proper understanding of what actually happens to plastic sheet material when it is vacuum formed, the process is fast moving out of the fancy goods field into engineering components and other technical applications. By virtue of lower initial machine costs and cheaply fabricated moulds, either in wood or die-cast, vacuum forming offers severe competition to orthodox moulding procedures in many instances. (Perhaps vacuum moulding is a better term, to differentiate the technique from vacuum bag formings.)

However, the vacuum former has to reckon with a number of problems, not the least of which is the variation in wall thickness which he must expect when fabricating many items, especially where a deep draw is involved. Such variations can of course be controlled to a certain extent by masking; however, there seems to be a fascinating field of study here for the plastics technologist to ponder. Is it a fact, for example, that vacuum forming extruded sheet is better, where the direction of draw follows the direction of extrusion, than pressed sheet, where the molecular structure may be expected to have a random pattern rather than orientated?

The fact that satisfactory results have been obtained with this technique using ⅛-in. sheets of high-impact polystyrene means that items such as drip trays for refrigerators come within the scope of vacuum forming. With flexible p.v.c., and cellulose acetate sheet, fine detail on the mould is faithfully reproduced.

* * *

Vinyl Toluene Production. Another chemical which so far has only been available in laboratory quantities has now been put on a commercial manufacturing basis in the U.S.A. The Dow Chemical Company has completed its plant for manufacturing vinyl toluene at Midland, Michigan. The new monomer is similar to styrene in chemical behaviours and similar in price. It is expected to have uses in the field of synthetic rubber, rubber reinforcing resins and polyester resins.

* * *

Better Bananas. South American banana growers are following the fashions in using transparent film for packaging their products. They claim that flavour is preserved better, moisture is retained and in their package the banana ripens to a brighter colour.

* * *

Improved Shoe Lining. Major W. H. Smith, Director of J. S. Smith (Mulliquid), Ltd., Leicester, recently explained a method of protecting unlined shoes by spraying the insides with a plastic solution. This prevents unlined shoes from ruining stockings by "sweating" and causing dye marks. Major Smith, who was speaking at a meeting of the Leicester branch of the British Boot and Shoe Institute, explained that the chief cost of this method was in labour but several Leicester firms are already adopting the process.

* * *

Epoxide Resin Mixtures. At a recent Plastics Institute meeting in London, Dr. Narracot of Shell Chemicals, Ltd., spoke of developments in epoxide resins particularly with reference to their use in glass fibre reinforced laminates. Interesting results have been obtained by this company's associate in the U.S.A. with mixtures of epoxides with other resins. Extensive tests already show the value of phenolic/epoxide mixtures and mixtures with polyamides and thiokol show excellent flexibility. No results have been published on work in this country but similar mixtures are being investigated. Both theory and practical results suggest that reaction occurs between the polymers.

* * *

Epoxide Laminate Car Body. Although the prices of these resins appear to prohibit their use in most reinforced plastics applications, the excellent properties of epoxide resin laminates suggests many uses particularly in the chemical field for piping. Much data should become available from the performance of a car which has been built by Mr. W. J. Marmion of Shell Chemicals, Ltd., made by the wet lay-up technique with glass cloth and Epikote resins. A photograph of the car appears on page 55.

* * *

Nylon Driving Belts. The outstanding strength of orientated nylon film and fibres has for some time tempted manufacturers of transmission belting. The main disadvantage is the low coefficience of friction of nylon. Ways of overcoming this include bonding the nylon to friction materials—leather/nylon laminate has already proved successful. *Machinery Lloyd* has described a belt woven from nylon with an inter-woven cotton cover to provide the necessary friction. The cotton provides the belt's grip and nylon its strength and endurance. The belting is manufactured by Lewis and Tylor Ltd., of Cardiff.

* * *

Graduate Course at Princeton University. *Chemical and Engineering News* reports that Princeton University, U.S.A., is offering a graduate plastics fellowship programme, leading to the M.S. degree in engineering. Instruction covers properties, evaluation, production, fabrication, design and application of materials, as well as chemistry of plastics. Fellowships with stipends of from $1,500 to $2,100 plus tuition and fees are available. Opportunities for employment as half-time research assistants at $1,500 per academic year are also available to students not on fellowships. Inquiries should be addressed to Louis F. Rahm, Director, Plastics Laboratory, 30 Charlton St., Princeton, N.J., U.S.A.

Secret Conference. A note appears on page 54 of *Plastics* this month concerning a meeting held recently by members of the reinforced plastics section of the British Plastics Federation. Having been called in secret the meeting naturally drew the attention of the daily press but due to the informative statement of Mr. H. A. Collinson, technical director of Leicester, Lovell and Co., Ltd., who was chairman of the conference, the reports contained little of the exaggeration normally attributed to news about plastics. Observers at the conference reported a healthy exchange of information among manufacturers as well as the Government departments represented, including the Admiralty, Ministry of Supply, Royal Aircraft Establishment, Farnborough, and the Military Experimental Establishment, Christchurch, who are all engaged on experimental work in reinforced plastics.

It is interesting to note that the reinforced plastics section of the American Society of Plastics Industry, which is equivalent to the British Plastics Federation, now attracts some 3,000 members to its annual technical conference where progress and developments are discussed freely and openly.

* * *

Six inches of plastics. Readers of our feature "Letters to the Editor" only see a part of the inquiries that reach the offices of *Plastics*. Can you tell us the manufacturers of door handles, p.v.c. tube, table covers, etc. . . . ? Whose trade mark is . . . ? How can we find . . . ? Most of these problems—both technical and commercial—can be dealt with quickly and efficiently.

There is one type of inquiry, however, that we always find difficult to answer. It comes from the man who wants three melamine plates, or five feet of blue p.v.c. sheet or six inches of pink casein rod. Obviously it would be impracticable for manufacturers to supply such small quantities. Nor do many of the wholesalers and stockists of plastics materials like to deal in retail quantities. For some of the materials, such as Perspex, it is possible to go to handicrafts and hobbies shops. But for many types of plastics materials and even such finished products as tableware there does not appear to be an efficient retail outlet.

Manufacturers of decorative laminates have recently overcome this difficulty by selling small sheets (pre-cut to fit table-tops) through hardware shops, supported by advertising in the popular Press. Their efforts appear to have been highly successful. Similar action by other manufacturers might well help to increase the demand for various plastics materials and products.

* * *

New vinyl plasticizers. Acetoglycerides-acetostearins and acetooleins made by substituting acetic acid for longer chain fatty acids in glycerides of natural fats—show promise as secondary plasticizers for vinyl resins in tests at U.S. Department of Agriculture. The fats should prove to be suitable extenders for dioctyl sebacate. Acetoglycerides are being produced on a pilot-plant scale by a commercial company.

PLASTIKON.

A New Range of Expanded Resins

By D. N. HUNTER

The author, formerly on the research staff of the English Electric Co. Ltd., and now an industrial chemist with L. B. Holliday and Co. Ltd., has long been interested in the use of plastics in lightweight construction. In this article he describes a range of resins he has developed and techniques called for in their use.

ENGINEERS are continually seeking to reduce the weight of structures which require to be moved, since the greater the mass moved, the greater the amount of energy required. The main problem lies in the reduction in weight, while maintaining sufficient strength to enable the structure to function satisfactorily over the calculated period. This strength/weight ratio is of particular importance to the aircraft designer, where payload is governed by the weight of the empty aeroplane.

A very striking example of the necessity to reduce the weight of a structure to a minimum, while maintaining sufficient strength to withstand high pressures and acceleration stresses, is given by the design of a military or high-altitude research rocket. In this case, all the energy used to propel the rocket is carried within the rocket, as opposed to the internal-combustion and jet engine, which utilizes atmospheric oxygen. Careful design can enable a structure to carry up to five times its own weight in fuel and oxidant at the start of the flight.

In the search for lightweight materials having a high strength for weight ratio, cellular compounds have been an obvious possibility. It has been found in practice that the combination of a cellular or expanded core and a metal, wood or polyester/glass fibre skin results in very strong lightweight structures. One of the main factors which appears to have arrested the development of the compound structure with the expanded core is the lack of materials which can be expanded *in situ* and adhere firmly to the outer components. Most of the structures utilized to date have been fabricated by the machining of an expanded block of resin or ebonite, with the subsequent laminating of the outer-skin components, using suitable adhesives.

For an *in-situ* expanding resin, the following requirements can be stated:—

1. The material should be capable of being poured into any cavity, between sheets of plywood or aluminium for sandwich construction, or into a hollow shell, and should subsequently foam up and set to a volume predetermined by the amount of resin used and/or the amount of expanding agent incorporated.
2. Shrinkage on curing should be maintained at a minimum in order to ensure no weakening of the bond between the case, or external material, and the expanded core.
3. The material should lend itself readily to workshop practice, be non-injurious to personnel, and have a reasonable storage life.
4. A range of resins should be available, each having special properties and applications. This will allow for selection by the designer and fabricator.

Types of Expanding Resins

In-situ expanding resins can be classified under three groups: 1. Resins which expand due to formation. 2. Resins which expand by the addition of an agent. 3. Resins which expand due to combination with an agent.

A good example of material which comes under group 1 is given by the polyurethanes, or alkyd/isocyanate, combination, first developed in Germany during the war under the name of Moltoprens. The material is provided in two components, which are mixed immediately prior to use. One component consists of an alkyd resin manufactured from a dibasic acid, and a polyhydric alcohol. The other component is a member of the very reactive group of organic compounds known as isocyanates.

If a sample of the well-known glycerol/phthalic anhydride resin is prepared (half molecule of phthalic anhydride with one-third mol of glycerine) to the brittle stage (230° C.), the product will be found to still have quite a considerable number of carboxylic-acid groups un-reacted (indicated by the acid number). There are two points of reactivity on the alkyd resin molecule, one being the OH group and the other the COOH group. The isocyanate molecule reacts with the first and forms a linkage without developing any by-products, but in the latter case the linkage is formed with the splitting-off of carbon dioxide gas. It is this CO_2 gas which provides the expansion, and since the amount of gas generated is entirely dependent on the number of carboxylic acid groups remaining free to react in the alkyd resin, the value of the resin acid number is directly related to the degree of expansion obtainable.

If a portion of the resin is powdered and mixed with half its weight of phenyl isocyanate and heated at 100° C. in a container at least 10 times the volume of the mixture, in a very short space of time a strong reaction sets in, the resin foaming and expanding rapidly. After a short interval the reaction dies down, and unless the resin is chilled the expanded structure begins to collapse, because the material is still thermoplastic. If, however, instead of using phenyl isocyanate, which is mono functional, the experiment is repeated using meta toluene di-isocyanate, the resin foams up and sets hard without collapsing. Although the same quantity of CO_2 is generated in both cases, where the mono functional phenyl isocyanate is used no cross-linking takes place and the material remains thermoplastic. The di-isocyanate, however, forms cross-linkages and, therefore, a permanent set.

Examination of the glycerol/phthalic anhydride resin, meta toluene di-isocyanate, expanded material, shows that, while the material exhibits the desired reaction mechanism, the final product is far too brittle and mechanically weak for structural application. Alkyd resins based on adipic and sebacic acids have proved more suitable for this purpose. Two obvious faults are apparent in the use of this type of product. First, the isocyanates are rather obnoxious substances and require careful handling in the workshop and, secondly, the degree of expansion is directly related to the resin acid number and one cannot obtain a wide density range from any one batch of resin. On the other hand, the material gives a very good bond on most surfaces.

The second group in the classification consists of resins which are admixed with expanding agents, and the mixtures heated to a temperature at which the agent decomposes to liberate a gas, usually nitrogen. Unless the resin is thermosetting, the expanded mass has to be chilled to prevent collapse, and if the resin is thermosetting it is very difficult to make the cross-linking or gelling point coincide with the point of maximum expansion.

The new range of resins, discussed in the following general outline, are in the third class. Thermosetting resins are used, together with an expanding agent which liberates nitrogen by actual combination with the resin during the curing process, and in which the gel point is coincident with the point of maximum expansion. Several resins are being developed, and two have been proved by small-scale usage. These are designated: W.S.1, a warm-setting resin, tough and heat resisting; W.S.2, a warm-setting resin somewhat harder than W.S.1, but slightly more brittle.

Cold-setting products which do not require heat during the process, the whole operation taking place at room temperature, have also been made experimentally.

Resins W.S.1 and 2 are pale amber to colourless syrups which will keep without the addition of the accelerator for a period of approximately three months at room temperature. They can be coloured in the usual manner for identification purposes or, if the expanded structure is to be visible in the finished article, for appearance.

The expander E is a pale micro crystalline powder, which keeps indefinitely at room temperature in a sealed container, but generates nitrogen gas when dissolved in the resin and warmed to 40-100° C.

Accelerator A is a white powder with good storage properties and dissolves readily in the resin.

Small quantities can be readily mixed by hand, but for amounts of 10 lb. or more some form of mechanical stirring is advisable. In all the formulations the amount of each component added to the resin is based on parts by weight to 100 parts of resin weight. The resin is first weighed into some suitable container, and

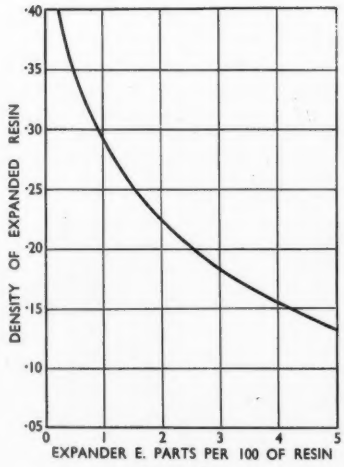


Figure 1.

the expander E added. The amount of E added controls the density, and therefore the volume, of the final product. A graph illustrating the variation of density with the quantity of E used is shown in Fig. 1. When the expander E has dissolved in the resin (after one or two minutes' stirring), the accelerator A is added and the stirring continued until this product is dissolved.

Addition of the accelerator to the resin reduces the length of curing time required and up to 10% can be used successfully; 10% reduces the curing time to approximately one-fiftieth of the period required for the pure resin at the same temperature. The amount of accelerator added to the mix also controls to some extent the pore size in the finished expanded structure.

The resin is now ready for pouring into the mould or cavity, unless it is required to incorporate a filler. In practice it has been found possible to add up to 10 parts of a filler, such as sawdust, to 100 parts of resin and still have a pourable mixture. If, however, a higher proportion of filler is required, it is advisable to first impregnate the filler with the resin mixture and then pack the material into the cavity or mould. A filler which has been found to give remarkably strong lightweight expanded structures with W.S.1 and 2 is $\frac{3}{8}$-in. chopped strand glass fibre, which can either be packed into the cavity prior to adding the resin mixture or impregnated with the latter and then packed.

At 150° C. the resin containing the expander E and the accelerator A will remain usable for a period up to three days. At 50-100° C., however, expansion and curing will take place in from four hours to 15 minutes.

For the production of expanded lightweight blocks, the resin mixture is poured into simple open-top moulds of the required size and shape and heated to a temperature of 50-100° C. At 50° C. resin containing 5% A will require a heating period of approximately 8 hours to attain full mechanical properties; at 70° C., 4 hours, and at 100° C., 2 hours. The lower temperatures and longer times are better if mechanical strength is of major importance. Before casting it is necessary to know first, the volume of the mould and, secondly, the required density of the finished block. From these values the weight of resin and expander E can soon be calculated.

A special technique was evolved for sandwich construction. The equipment used for the experiments consisted of a jig or mould capable of producing specimens 10 x 10 x 1 cm., and is illustrated in Fig. 2. This mould consists essentially of a centre frame with an opening through the middle lined with a rubber gasket and measuring the overall dimensions of the finished piece. A gate is cut into the top edge of this frame in order to provide entry for the liquid resin. The frame can be opened out to facilitate removal of the finished piece.

The two outer layers of the sandwich are placed either side of this frame and then covered by the two thin copper plates (which are supported on wood frames). The whole is located and held securely in position by four bolts, springs and wing nuts (see

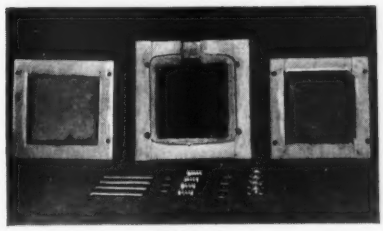


Figure 2.

assembled mould in Fig. 3). Springs are incorporated in order to provide a steady pressure on the gasket to ensure good sealing, and the newly-formed core, to ensure good bonding. A dull black finish is applied to the exposed surfaces of the copper plates to provide maximum absorption of the light from the infra-red lamps

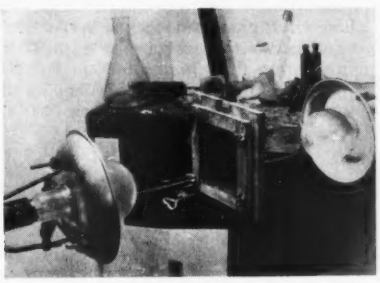


Figure 3.

and, therefore, maximum heating efficiency. Prior to placing the two outer portions of the sandwich (plywood or aluminium) into the mould, the inside surfaces of the former may be coated with an alcoholic solution of resin W.S.1 or 2, or, if necessary, a co-adhesive, in order to provide a good bond with the expanded core.

The assembled mould is clamped into place between two infra-red lamps, the position of which has been determined previously by filling the empty mould with water and finding by trial the distance at which water will be raised to 60° C. from room temperature in 15 minutes. A quantity of resin mixture, of a composition designed to give a calculated density and an amount in accordance with the free space inside the mould (allowing 1-2% excess) is poured into the cavity. If so desired, this

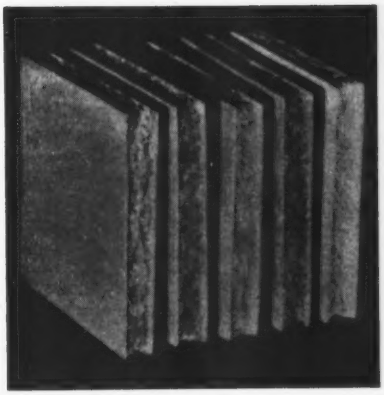


Figure 4.

resin mixture can be preheated rapidly to 40-50° C. to make for quicker pouring and shorter reaction time. The infra-red lamps are switched on and in 15 to 20 minutes the resin mixture should foam up, a small excess forcing its way out of the mould gate.

Directly after expansion the resin gels and hardening proceeds. By moving the lamps further away from the mould the final hardening can be carried out at a lower temperature, a factor which appears to be beneficial in connection with mechanical strength. On completing the cure, the finished piece (see samples Fig. 4) can be removed by unscrewing the wing nuts, taking off the copper end-frames and opening out the centre frame.

For the production of large sandwich components, a strong wire mesh (steel) could be overlaid on the copper plates to provide additional support for the latter, which should remain as thin as possible to ensure good heat transfer. Although the process using infra-red heating, described above, is more convenient for large assemblies, the process can be carried out in suitable stoves if so desired.

This process appears to lend itself most readily to the production of complete boat hulls, aircraft, furniture, etc. A hollow shell can be constructed and the calculated amount of resin mixture poured into the cavity. Heat is applied and the space becomes filled with a tough core. The final article has not appreciably increased in weight; the strength factor is increased.

Many uses can be visualized in the aircraft industry. Complete wing structures could be filled with the expanded resin, with the fuel tanks located in position prior to foaming the resin and subsequently becoming an integral part of the wing. The infra-red heating technique might be satisfactory for such a process. Expanded resin should be suitable for use with radar and. forming the core between glass fibre laminates, a strong lightweight cowling could be fabricated.

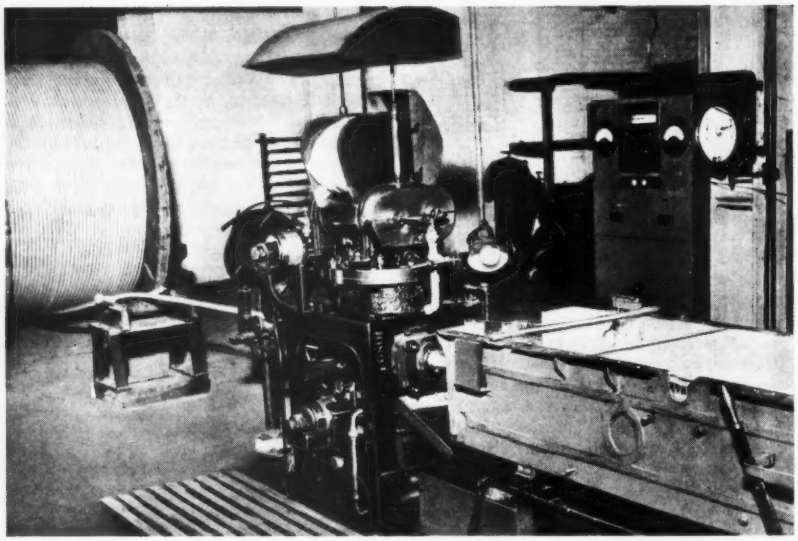
The resistance to buckling of aluminium tubes should be greatly increased by filling with the expanded material. A uniform section could be obtained by rotating the tubes slowly about the centre line.

The writer now plans to use these expanded resins in the manufacture of liquid-propellant rockets, offering great saving in weight and a corresponding increase in range and performance.

GEAR-PUMP EXTRUSION

The notes below detail briefly an extrusion technique which has been used for many years by The Telegraph Construction and Maintenance Co., Ltd. Although the method has certain disadvantages, which include difficulty in cleaning the machines, and their unsuitability at the moment for electrical or high-pressure steam heating, the company feels that redesigning may bring machines of this type back into favour.

THE modern method of extruding plastics is undoubtedly to use the cold-feed principle which has been adapted from the old rubber "forcer." Historically, however, it is interesting to consider another method which has been used by The Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, S.E.10, for 60 years. This method, using the gear-pump extruder, was originally designed for gutta-percha, the natural plastic which has served the world's submarine cable links so well for over 100 years. With modification it was capable of handling some grades of polythene during the war and in this capacity did yeoman service. With tougher grades of polythene it has been realized that the machine in its present form is unsuitable and the gear-pump machine is therefore retained mainly for extruding gutta-percha, although hundreds of thousands of miles of polythene-type cables have been extruded on these machines. In addition to this the machines have made tens of thousands of miles of gutta-percha insulated submarine cable since 1887.



Telcothene coating being applied by gear-pump extrusion to submarine cable.

The principles involved in the construction of these machines were the subject of a patent by Willoughby Smith in 1887 (No. 17,768). The figure shows drawings of side and front elevations of the machine and a plan of the gear pump.

The principle of operation is that the hot plastic from a mixer of the open double-bladed kneader type (such as that by Werner-Pfleiderer or Baker-Perkins) is placed on top of the steam-heated feed rollers (bb^1) which force it down the passage (f) into the gear-pump chamber (h). Within this chamber is a toothed ring (k) and an eccentric toothed pinion (l) gearing within it. The lower end of the axis (l^1) of this pinion carries a worm wheel (l^2) driven by the belt pulleys (l^4). In later designs, of course, these belts have been replaced by chain drive via PIV gearing from an individual motor. Between the ring (k) and the pinion (l) there is, opposite to the point where they gear with each other, a partition fixed to the top and bottom covers of the drum (h). In the bottom cover of the drum (h) there is an opening on the opposite side of the partition to the opening (g). This opening leads to a duct (o) by which the plastics material is conveyed to the die box (p) which is traversed horizontally by the wire to be covered, the wire when covered leaving the die box through the die.

Fig. 1

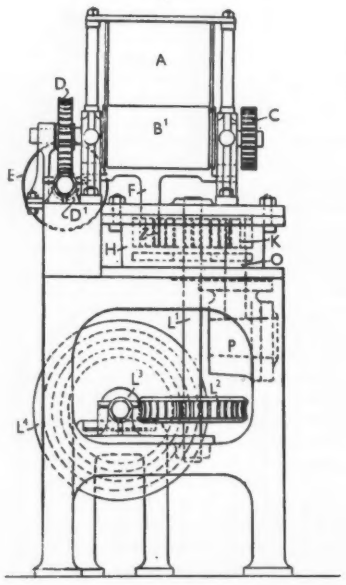
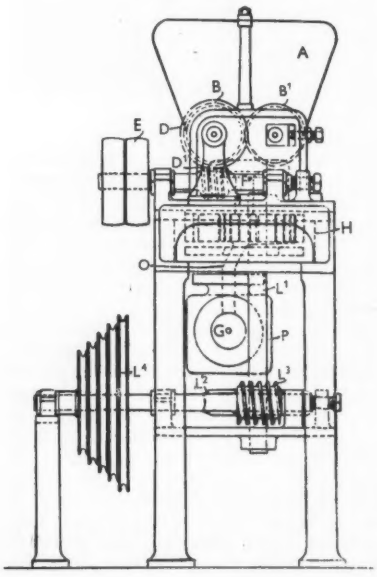


Fig. 2



For materials possessing a viscosity between certain limits these machines have the advantage that a fixed measured quantity of plastics material is delivered to the die box at each revolution of the pump. They also have the advantage that an unusually small amount of power is necessary to drive them (as compared with a modern cold-feed extruder which must heat the plastic as well as extrude it). Probably the most outstanding advantage possessed by these machines is the large output available from a machine of such small size and weight. Enormous pressure is developed on the high-pressure side of the gear pump which maintains this pressure regardless of the viscosity changes in the material fed to the machine. Material is also supplied at fairly high pressure to the gear pump—in fact a smooth positive feed. These factors contribute largely to the smooth extrusion of large quantities of plastics materials. Over 300 lb. per hour of polythene has been passed by these machines on large cable. Multiline extrusion is quite usual from a suitable die box (which is fed from both sides). Four lines are common practice. The high speed of production attained by the covering of several lines at once is an obvious advantage. The streamlining complications introduced into the modern small extruder head in attempting to cover more than one line at once are considerable in that the material enters from one side only.

Polyvinyl Chloride Extrusions

Some Properties, Applications and Test Procedures

By E. E. HALLS

Dealing first of all with plasticizer migration and consequences thereof, the author goes on to identify some important applications of extruded p.v.c., and includes several test procedures and results

THE polyvinyl chloride plastics are based on a relatively hard and rigid resin and to impart elastomeric properties plasticizers are incorporated. P.v.c. extrusions therefore range from the rigid to the very flexible. All will contain a small percentage of lubricant to facilitate the fabrication of the compound ready for extrusion, as well as a small percentage of additive to stabilize the material against the adverse effect of light and heat. All may contain appropriate colorants if required for any specific application. It is the plasticizer, however, which is the most important constituent with particular respect to the mechanical and physical properties of the finished product.

Truly rigid p.v.c. contains no plasticizer, but some grades, described as rigid, contain small amounts; the flexible grades may include up to 50% or more of this ingredient. Flexibility is dependent upon the nature of the plasticizer, as well as being proportional to the amount present. The mechanical properties of the material can be defined by tensile strength and elongation of a specified shape of test piece, but often more conveniently by a hardness test, e.g. a Shore durometer numeral. There are, however, other properties that have to be considered, and most of these are important in all applications, whether the latter be primarily mechanical, physical, chemical or electrical in nature.

Migration of Plasticizer

The p.v.c. resin and plasticizer only form a physical mixture, with the plasticizer in solution in the resin or as a uniform mechanical dispersion. The plasticizer can, according to its nature, and the ambient conditions, "sweat-out" to give a wet, oil-like film, evaporating or actually migrating into other materials in contact with it. Thermal conditions have a profound influence upon these changes, an increase in temperature accelerating the "sweating" and migration processes, and naturally augmenting volatilization or evaporation. Humidity, too, plays a part and experience indicates that water or water vapour will expel plasticizer presumably by a process akin to osmosis. By attention to the nature of the plasticizer employed, these adverse phenomena can be reduced to a degree that is of no consequence, or eliminated altogether.

Instability with respect to plasticizer also means uncertainty with respect to dimensions. Under "dry" conditions, loss of plasticizer signifies a reduction in volume, and therefore a contraction in dimensions. This does not necessarily occur in all directions, and the retraction may predominate in one direction, usually that of extrusion. In fact, often there is major shrinkage in length and an actual swelling in thickness. Under "wet" conditions, e.g. complete immersion in water or in an aqueous solution, if the plasticizer is expelled and replaced by water, the rate of absorption may initially be greater than the loss of plasticizer, so that at first there may be an expansion, followed later by a contraction. Conditions of condensation and humidity may cause the same kind of phenomenon. Dimensional stability in some applications is of prime importance because of fit and retention of precise fit. In some cases, it is desirable to know what changes are to be expected and they can then be catered for in the design or assembly of the parts. In others, it is of little or no consequence. The point stressed, however, is that the possibilities should not be overlooked, because appropriate extrusion materials are available and should be selected to suit the intended application.

Sweating of plasticizer is evidenced by the appearance of an oily film over the extrusion and adjacent parts, and apart from the obvious objections of unsightliness, contamination of the surrounding areas and possibility of transfer by handling onto other surfaces, there may be other drawbacks, e.g. contamination of solutions in chemical applications, corrosion or loss of insulation in electrical equipment, amongst others.

Migration of plasticizer is not always so obvious in the visual sense. It occurs whenever p.v.c. is in contact with other thermoplastic materials. With two p.v.c.s of different migratory plasticizer contents, transfer from the higher concentration to the lower concentration will gradually occur till equilibrium is attained. A migratory plasticizer will pass from a p.v.c. containing it into one having a non-migratory ingredient. In all these cases, the only effect may be a hardening of the material losing plasticizer, and a softening of the one gaining it. A plasticizer may migrate into polythene, causing a gradual degradation in its low loss qualities, and ultimately some mechanical deterioration. With cellulose ester plastics, nitro-cellulose, cellulose acetate and cellulose acetate butyrate, contact with p.v.c. plasticizer with materials which tend to migrate is accompanied by visual deterioration. Plasticizer rapidly transfers to the cellulose derivative which becomes sticky and ultimately the two products may weld together. Most troubles from this source have been experienced from contact between flexible p.v.c. and cellulose finishes. Practically all leather and wood finishes today are based on nitro-cellulose and so are many metal finishes. Shellac finishes are susceptible to the same deterioration, although it is not so evident. Air-dried oil and synthetic finishes are affected very much more slowly, while stoved enamels, if properly thermo-set, withstand the contact without deterioration.

Effect of Plasticizer Loss on P.V.C. Applications

This question of migration of plasticizer is one that affects many applications of flexible p.v.c. It is of consequence in automobile fittings where flexible p.v.c. may contact leather, wood or metal parts. In electrical and other applications where flexible p.v.c. is chosen as a sealing gasket for boxes, or as a dust excluder for cabinets and cubicles, any possible deterioration is avoided by ensuring stoved finishes on the metal work. In wall panelling, where extruded section is used to obscure the junctions of the panels, the plasticizer-free, rigid type of p.v.c. is employed, so that no difficulties arise; in any case, the panelling would be urea, melamine or phenolic laminate, which are thermosetting resin products, and therefore they would be unharmed.

The migration of plasticizer from flexible p.v.c. need not be the cause of alarm, provided the possibility is appreciated, and trouble avoided either by ensuring that the other materials in contact are "safe" ones, or by using a p.v.c. in which only a non-migratory plasticizer is incorporated. In this connection, it must be mentioned that no cases of migration into nylon have been reported, although nylon is a thermoplastic. In fact, there are examples where the extrusion of a thin layer of nylon has been used to prevent transfer of plasticizer from p.v.c. into other materials.

The loss of plasticizer by evaporation, or by expulsion by aqueous solutions or water vapour, is evidenced by gradual hardening and shrinkage. The extent to which these are detrimental is determined by the nature of the application, and again therefore grades should be selected to be most suited for the purpose.

Rigid Polyvinyl Chloride

Rigid p.v.c., available in a wide range of colours, is an invaluable material on account of its unique properties, which include high mechanical strength in all senses (tensile, compression, impact and cross breaking), excellent electrical properties at power frequencies, and very good resistance to a wide range of chemicals. At present, the material cost is relatively high, and the extensive applications in which it has established itself at the expense of more conventional materials is a tribute to its qualities.

In the electrical industry, rigid p.v.c. has been found to be the most stable "label material." In this sense, the term label applies to miscellaneous components used for designation purposes, used in large quantities, but each having a different marking so that processes such as engraving and filling have to be employed.

These labels vary from the very tiny, rectangular or round, to fairly large. Some are long and narrow and would reflect any appreciable shrinkage with time quite badly. Methods of fixing vary widely. Some slide into a slotted frame, some are force-fitted

Table 1.—Performance of label materials under conditions of heat and/or damp conditions.

Test	Test Conditions	Material	Free	Fixed
A	Dry Heat, 16 hours at 70° C.	Rigid P.V.C. Urea Laminate Cellulose Acetate	Unaffected Little change Little change	Unaffected Little change Little change
B	Two Wet cycles of 16 hours at 55° C., 100% Humidity.	Rigid P.V.C. Urea Laminate Cellulose Acetate	Unaffected Little change Bowed 0.125 in.	Unaffected Bowed 0.25 in. Twisted
C	3 weeks at 40/50°C., 75% Humidity.	Rigid P.V.C. Urea Laminate Cellulose Acetate	—	Unaffected Unaffected Surface crinkled, and bowing 0.015 in. from fixing screws.
D	2 Weeks Dry Heat at 60° C.	Rigid P.V.C. Urea Laminate Cellulose Acetate	—	All unaffected
E	16 Hours Dry Heat at 70° C.	Rigid P.V.C. Urea Laminate Cellulose Acetate	—	Unaffected Darkened Wrinkled and severely bowed.

Table 2.—Changes in dimensions and weight of extruded white rigid p.v.c. strip under severe exposure conditions.

Test	Test Conditions	Period of Test in Weeks	Total Change Per Cent. in :—			
			Length	Width	Thickness	Weight
A	Dry Heat at 60°C.	1	Nil	Nil	Nil	−0.10
		4	Nil	Nil	−1.5	−0.10
		26	−2.5	+0.8	Nil	−0.05
		52	−2.5	+0.8	Nil	−0.05
B	Mild, Warm and Cool Humidity	1	Nil	Nil	+1.5	+0.07
		4	Nil	Nil	Nil	+0.07
		26	−1.5	+0.3	−1.5	+0.07
		52	−1.5	+0.3	−1.5	+0.03
C	Water Immersion at 25°C.	1	+1.5	Nil	+1.5	+0.10
		4	+1.5	+0.1	+1.5	+0.20
		26	+1.5	Nil	−3.0	+0.25
		52	+1.5	+0.1	−3.0	+0.25
D	Tropical Cycling (a) Dry Heat at 70°C. followed by	16 hr.	Nil	+0.6	Nil	−0.03
	(b) Wet Heat at 70°C. followed by	16 hr.	Nil	+0.7	+1.5	+0.35
	(c) Wet Heat at 70°C.	16 hr.	Nil	+0.9	+1.5	+0.55

into cavities. Others are assembled with fixing screws at appropriate centres. Casein and cellulose acetate types have always given trouble in service. The latter are evidenced by cockling or buckling in those rigidly held by screws, and by shrinkage and falling out of the frames in the case of those held freely in frames.

These labels can readily be made from rigid p.v.c. purchased in the form of extruded strip, For rectangular shapes, this can be obtained correct for width so that often only a parting-off operation is required. Other shapes can be blanked. Appropriate colour presents no difficulty. A comparison of performance of rigid p.v.c. with two other widely used label materials, viz. urea resin paper laminate and cellulose acetate under hot and wet conditions is given in table 1. All materials were 3/64 in. in thickness. For the first two tests, A and B, strips of material 7 in. long by $\frac{1}{2}$ in. wide were used. One piece of each sample was left free in the test chamber, and one piece trapped by fixing to a $\frac{1}{8}$-in. thick aluminium plate by means of screws spaced 6 in. apart. It will be seen that the specimens all withstood the short period dry heat test A (except that the cellulose acetate took some imprint from the wire shelf of the oven), whereas in the hot wet test only the rigid p.v.c. passed satisfactorily.

The remaining tests in table 1 were made on actual labels mounted normally by screw fixing. Under the very mild warm humidity conditions, test C, the acetate failed badly, p.v.c. and urea passing satisfactorily. In the case of the extended moderate dried heat, test D, all behaved well, whereas the short period at higher temperature, test E, eliminated the cellulose acetate and began to reveal changes in the urea laminate. These tests as a whole indicate the greater suitability of the extruded p.v.c. for rigidly fixed labels under rather adverse conditions of heat and dampness.

Testing for Changes in Dimension and Weight

Table 2 gives stability data on rigid p.v.c. strip (1/16 in. thickness, 1.0 in. width) under a variety of conditions, with test exposure extended to 12 months. In assessing the values quoted, the small width and thickness must be borne in mind.

Under moderate dry heat, test A, a sudden small shrinkage in length is observed in six months, with a corresponding very slight swelling in width, and, thereafter, constancy. Weight losses are very small.

Test B imposed day conditions of temperature 55-60° C. with 70-75% humidity, cooling at night to room temperature with increase in humidity to 100% and condensation. A fluctuation of warmth and dryness and also wetness, was thus imposed. The main dimensions of length and width first show change in six months, with slight decrease and very slight swelling respectively, but thereafter remaining stationary. The thickness shows a small expansion during the first half of the period and a small contraction in the second half. Weight changes are negligible.

Test C covers severe wet conditions by total submersion in water at room temperature. An initial small increase in length and negligible increase in width are maintained throughout the period. Thickness at first increases a little and then decreases. Weight changes become constant after a month, and are not unduly large.

Finally, the test series D are very severe yet no serious changes appear. The wet cycles each comprise 100% humidity at 70°C. for 16 hours followed by cooling off with condensation for 8 hours.

Under none of these tests was any deterioration visually revealed, i.e., no distortion, cracking or splitting, blistering or wrinkling, or discoloration. The materials can be deemed to withstand all the tests very well. The plasticizer content, including lubricant, of this white rigid p.v.c. was 3.4%.

For labels of all types, this material can, of course, serve many spheres other than the electrical and instrument industries. It offers a simple solution for name-plates for marking chemical processing tanks especially for the wide range of solutions employed in electroplating shops.

Rigid p.v.c. has also been used for small electrical insulators, for which the natural coloured extruded strip is a very convenient form of raw material. As a homogeneous material free from fibrous filler, high insulation resistance is maintained under damp conditions. This quality offers advantages over the phenolic resin paper laminate which is the conventional material to use in such applications. Rigid p.v.c. is also superior to ebonite, which in turn was replaced by phenolic laminate because it withstands moderate clamping pressures better without cold flow and does not suffer from the same loss of surface insulation upon exposure to light. Without long-term field trials, it is, however, too early to indicate the possibilities of the material in this direction. Stability under hot and wet conditions is shown by the data from extended tests in table 3. These show small decrease in length and width over the full test period of dry heat, but negligible dimensional movement under water immersion. This material was 0.040 in. thick and the plasticizer content (including lubricant) was 0.5%.

When cost is more favourable, the use of rigid extrusions in round and rectangular cross-section will receive more consideration for coil formers and for insulating busbars, and rectangular sections for the mounting

Table 3.—Changes in dimensions and weight of natural brown extruded rigid p.v.c. under severe exposure conditions.

Test	Test Conditions	Period of Test in Weeks	Total Change Per Cent. in :—			
			Length	Width	Thickness	Weight
A	Dry Heat at 60°C	1	−1.0	Nil	+0.3	−0.07
		4	−1.0	Nil	+0.6	−0.07
		26	−2.0	−1.0	+1.15	−0.07
		52	−2.0	−2.0	+1.5	−0.13
C	Water Immersion at 25°C	1	Nil	Nil	−1.2	+0.25
		4	+0.6	Nil	+0.8	+0.60
		26	+0.6	Nil	−0.3	+0.60
		52	+0.6	Nil	−0.3	+0.70

Table 4.—Dimensional changes in flexible p.v.c. extrusion under severe test conditions.

Test	Thickness of section, Inches	Test Conditions	Test Period in Weeks	Total Change Per Cent. in:—		
				Length	Width	Thickness
A	3/16	Dry Heat at 60°C.	1	Nil	Nil	Nil
			4	Nil	Nil	−0.8
			26	+2.0	−2.0	+4.0
B	3/16	Mild, Warm and Cool Humidity	1	Nil	Nil	Nil
			4	Nil	−1.0	Nil
			26	−0.5	−1.0	Nil
C	3/16	Water Immersion at 25°C.	1	Nil	Nil	Nil
			4	Nil	Nil	−1.6
			26	+0.5	Nil	Nil

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Mercury has already fixed his foot-wings to the wheels of our delivery vehicles, resulting in joy to our Customers, but fines for our drivers. (This idea *may* be adopted for railway goods wagons if the permission of the "Train-Spotters Union" can be obtained.)

Best of all, the winged steed Pegasus has promised a stand-by delivery service in the event of any temporary dislocation of road, rail, air and sea deliveries.

So, Gentlemen, you see that never more than today was justified that famous dictum . . . YOU'RE RIGHT WITH "NESTORITE".

NESTORITE **GRADE A.578/1**

HEAT & SHOCK RESISTING

Filler	Asbestos
Particle Size	Fibrous
Specific Gravity	1.90
Bulk Factor	10—16
Powder Density	.12—.18
Time of Cure of Test Cup (secs.)	120—150
Recommended Flow Range	5—8
Shrinkage (thou./inch)	1.5—3.0
Flowability (cm.)	7—8
Impact Strength (ft./lb.	.45—.60
Tensile Strength (lb./sq. in.)	5,000—8,000
Water Absorption (7 days) (mg.)	100—200
Heat Resistance (½ hr. at 400°C.) (lb.)	500
Plastic Yield Grading (°C.)	180
Blister Temperature (50°C. per hr. rise)	200—210
Shrinkage after heating 5" disc for 24 hrs. at 180° C. (thou./in.)	1.5
Electric Strength at 90°C. minute value (V/mil.)	10—30
Surface Resistivity after immersion (log₁₀ohms)	8.0—9.0
Volume Resistivity (as moulded) (log₁₀ohm cm.)	8.0—9.0

A resin-asbestos material suitable for mechanical articles where continuous heat resistance is required. Fluffy, but can be "snow-balled".

℞ YOU'RE RIGHT WITH 'NESTORITE'

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EINAR HOLMARK, 19, Gl. Kongevej,
Copenhagen V. Denmark.

brackets or heavy components such as transformers and motors assembled on frameworks and cubicles.

Flexible p.v.c. extrusions (apart from cable coverings and sleevings) have been used for sealing boxes and cubicles against dust and air ingress. As a gasket for sealing boxes (where box and cover have been aluminium castings) the material has successfully been employed as a fully "trapped" cushion. In this design the box has been provided with a channel around the periphery of the top edge and the flexible p.v.c. gasket has been a close fit in this, reaching short of the edge level. It has been anchored with a layer of p.v.c. cement in the base of the channel. The cover is provided with a corresponding raised portion that drops onto the gasket, and cover and box can then be tightened by peripheral screws or other clamping device. This kind of gasket is established as satisfactory, because the trapped cushioning material cannot spread, and its compressibility can be taken precisely into consideration in design when settling dimensions of channel and boss.

For sealing the doors of cubicles of electrical equipment, rubber in soft and sponge qualities and of varying sections has never been entirely satisfactory; ageing and perishing, and methods of fixing are still problems. Nor has the difficulty yet been fully solved with flexible p.v.c. extrusions. Using designs other than the fully trapped type, the high permanent set of the material presents a problem. Fixing at reasonable cost, unless sticking is reinforced by riveting, or by holding an extension of the section in a fold in the metal surround, is also a difficulty.

P.v.c. Used to Combat Vibration, and as a Packing Material

As a buffer material to damp vibration, or as a packing to restrict or prohibit movement, the same type of flexible p.v.c. is usefully employed. A square or rectangular cross-section is perhaps the most widely used but rounds and angles are also employed. The extrusions can be bought in continuous lengths, and are readily cut to the desired size.

Table 5.—Water absorption values of flexible p.v.c. Extrusion at 25°C.

Period of Immersion	Water Absorption Per Cent. for Thickness of Extrusion :—	
	3/16 in.	¼ in.
1 day	0.2	<0.1
1 week	0.5	0.3
4 weeks	0.7	0.5
13 weeks	1.0	0.8
26 weeks	3.3	2.2

One type of flexible extruded material used satisfactorily in these applications has a hardness value of 60 to 65 (Shore Durometer numbers) and a plasticizer content of 38 to 40%, and a lead carbonate stabilizer of 1.5 to 2%. The plasticizer is of the non-sweat, non-volatile variety. For this type of composition, dimensional stability values are shown in table 4 for extended exposure to dry heat at 60° C., for the warm and cool mild humidity test, and for water immersion. The results quoted represent an exceedingly good and stable flexible p.v.c. Actual weights of water absorption are given in table 5 and hardness changes when exposed to dry heat at 70° C. are presented in table 6. These changes are not great and experience confirms that they do not adversely influence the applications in question.

Table 6.—Hardness changes in flexible p.v.c. extrusion after dry heat exposure at 70°C in air.

Thickness of Extrusion.	Period of Heat Exposure in Days	Hardness Value (Shore Durometer)
3/16 in.	0	65
	1	61
	7	63
	14	68
¼ in.	0	62
	1	56
	7	60
	14	60

Oil Immersion

Use of flexible extrusions involving continuous immersion in oil have been considered, and in fact, some are practised. However, such applications must be regarded with caution, because oil tends to dissolve the plasticizer, at least superficially, and shrinkage and hardening result. This is clearly demonstrated by the values in table 7, taken on the materials after immersion in transformer oil at an elevated temperature of 60° C. Primarily, therefore, this grade of flexible p.v.c. extrusion is not suitable in applications of this kind.

Chemical Applications

As a special example of applications in the chemical industry, the case of the electroplating shop can be cited, particularly as this is often badly neglected from the plant services angle, especially in relation to the use of modern materials. A good application for rigid p.v.c. extrusions in this sphere concerns the exhaust trunkings. These have to take care of spray from various solutions from strong acid to strong alkali, nitrous fume from bright dip operations, vapours from fluoric acid solutions, chromic acid spray, steam, etc. The best material established in the past for long service over many years is chemical stoneware. This is expensive and heavy to install and an installation does not lend itself to frequent changes in plant arrangement. The latter is essential in modern plants handling work which constantly fluctuates. Galvanized iron and aluminium are used for such work, and are very short lived and therefore unsatisfactory.

Rigid p.v.c. is ideal in this field. Generally standard sections are purchased and welded to give the line of exhausting required. However, it is preferable to weld flanges to the individual lengths so that they can be bolted in position. This facilitates changes from time to time. A cushioning gasket can be included between flanges. Rubber is suitable but a better material is p.t.f.e. Flexible p.v.c. is unsuitable for these gaskets unless the non-migratory plasticizer type is chosen because the plasticizer from it transfers to the rigid material and a cemented junction may result.

The rigid p.v.c. extrusions of circular section are ideal for most pipework applications in the plating shop, i.e. for the miscellany of connections between the plating vats and the filters, storage tanks and mixing vessels. For a very wide range of solutions, nothing is extracted from the p.v.c. to harm the solution or the process in which it is employed. Other sections too have an important use. Still tanks and dip vats are protected around the peripheral edge by wood capping to minimize mechanical damage to the vat and its lining from impact by the work load when inserted and withdrawn. A p.v.c. channel either fully rigid or lightly plasticized can do a better job than wood in this application. Similarly, in automatic plants to protect busbars and vat ends from drippings, rigid p.v.c. sections have been employed and seem to be the most suitable material.

The small dimensional changes which occur on the diameters of piping of this kind have been recorded under the accelerated test previously mentioned, and those measured on samples cut from actual extrusions, are shown in table 8 for a tube of 1⅛ in. external diameter, and 5/16 in. wall thickness.

Flexible polyvinyl extrusions are used for pump connections, return ends of pipe lines to vats and so forth, i.e. where a flexible lead is necessary. Transparent forms are available and found to be useful where the outlet cannot be seen and some visual indication of flow is required. Care has to be exercised in selection to locate a material with the lowest propensity for plasticizer to be leached out by the solution. Contamination of the latter with organic matter often cannot be tolerated, e.g. chromium electrolytes, chromate passivation solutions, etc., especially when replacement of drag-out losses is very small.

Table 7.—Influence of extended immersion in oil at 60° C on dimensions and hardness of flexible p.v.c. extrusion.

Thickness of Extrusion	Initial Hardness	Period of Immersion in Weeks	Hardness	Total Per Cent. Decrease in:—		
				Length	Width	Thickness
3/16 in.	65	1	60	4.0	3.0	5.6
		4	90	7.0	6.0	8.8
		26	100	15.0	11.0	12.8
¼ in.	62	1	78	2.0	2.0	2.0
		4	88	4.5	4.0	3.2
		26	95	8.5	8.0	9.3

Table 8.—Changes in dimensions and weight when rigid p.v.c. extruded tube is exposed to severe test conditions.

Test	Test Conditions	Period of Test in Weeks.	Total Per Cent. Change in:—		
			External Diameter	Internal Diameter	Weight
A	Dry Heat at 60° C.	1	+0.1	-0.5	-0.20
		13	+0.2	-0.6	-0.40
B	Mild, Warm and Cool Humidity.	1	+0.1	+1.4	+0.07
		13	+0.4	+1.5	+0.05
		52	+0.5	+1.6	-0.03
C	Water Immersion at 25° C.	1	Nil	-1.9	+0.10
		13	+0.3	-1.3	+0.55
		52	+0.5	-1.0	+0.90

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2s. 8d. each (including postage).

B.P. 697,378. Feeding device for moulding machines. To: Armstrong Cork Co. (U.S.A.). Div. out of B.P. 697,316 (see above).

B.P. 697,452. Production of emulsions of polyvinyl ester polymers. Vinyl Products, Ltd., H. Warson.

B.P. 697,466. Apparatus for sealing together the edges of thermoplastic sheets. F. C. Hester. To: Oppenheimer Casing Co. (U.K.), Ltd.

Refers to polythene sheets for moisture-proof hygienic packages. The apparatus includes a resilient polyvinyl chloride support for the sheets and a cover strip of glass fibre or tracing cloth to prevent adhering of the sheets to the heating elements or overheating.

B.P. 697,479. Catalytic agents for acid-curing thermosetting amino-plast condensation products. J. O. Percival, D. A. Williams. To: Monsanto Chemical Co. (U.S.A.).

B.P. 697,490. Production of interpolymerization products and plastic masses therefrom. To: Badische Anilin- and Soda-Fabrik (I.G. Farbenindustrie A.G.) (Germany).

Used for impregnating, waterproof coating, on packages for hot sealing, as adhesive (e.g., for inorganic building materials), as colour-binding agent.

B.P. 697,524. Machine and method for producing phonograph disc records. A. I. Massler. To: M. and W. Co. Inc.

An automatic injection-moulding machine with cooling water circulating in the die heads forming a disc with an integral sprue within the bushing to be removed by a ram-rod and automatic removal of the moulded disc.

B.P. 697,547. Pencil and like sharpening device. W. Wolff-Kunzi (Switzerland).

B.P. 697,573. Fabric-examining form. R. E. Hunt. To: Kilbourn Martin, Ltd.

A stocking-examining form is made from a flat tapered centre blade with radial webs (cruciform section) and a detachable heel piece. Black acrylic is a preferred material.

B.P. 697,579. Cutting machine for the production of granular material. P. Coste. To: Coste et Chevaleyre.

Production of injection-moulding granules.

B.P. 697,580. Constructional elements for windows. T. Klatte (Germany).

Corner members constructed as hollow spigots engage in rod-shaped hollow-profile members. The elements are made of thermosetting synthetic resins.

B.P. 697,604. Resinous copolymers adhesives and process of making the same. To: National Starch Products Inc. (U.S.A.).

Copolymerization in presence of a catalyst of monomeric vinyl acetate and of certain acid anhydrides.

B.P. 697,626. Process for making phenolic moulding powders. To: Montecatini Soc. Gen. per l'Industria Mineraria e Chimica (Italy).

Fillers, lubricant, dyestuffs are intimately mixed with an aqueous solution of pure monomeric phenol alcohols and dried at under 60° C.

B.P. 697,627. Process and apparatus for moulding thermoplastic materials. W. E. Meissner (U.S.A.).

Reinforcements are disposed between thermoplastic pellicles, the pellicles shaped and contacted with a fused or hot salt of a higher melting point than the pellicles. The salt is then removed from the moulded product.

B.P. 697,723. Capsules. John Tye and Son, Ltd., J. B. Bignell, Thessco Industrial Research, Ltd., J. C. Briggs.

The capsule of thermoplastic material is divided into two compartments after insertion of a membrane (paper) by pinching the parts and applying heat along the division line. This weak seal permits intercommunication by manually squeezing one of the compartments without bursting the capsule, e.g., for mixing components of dental amalgam.

B.P. 697,728. Lighting fittings. N. W. Harding.

Louvre unit of zig-zag or serpentine shape forming honeycomb cells.

B.P. 697,762. Face masks for use in the administration of oxygen and other gases. G. W. Higgs.

The masks are formed of polyvinyl chloride or polythene sheets.

B.P. 697,763. Moulding plastic materials. To: Polymer Corp. (add to B.P. 661,166).

Refers to polyamide materials.

B.P. 697,791. Process for making moulded articles, in particular boards, of cellulosic material. E. Rohrer, J. Egli (Switzerland).

The synthetic resin component is, e.g., a phenol plastic or a urea plastic.

B.P. 697,798. Stabilized vinylidene chloride compositions. A. F. Daglish, D. Faulkner. To: Distillers Co., Ltd.

Protection against deterioration by light is obtained by incorporating a hydroxybenzophenone.

B.P. 697,801. Modified water-soluble urea formaldehyde resins. T. J. Suen, A. M. Schiller. To: American Cyanamide Co. (U.S.A.).

B.P. 697,805. Compositions suitable for filling electrical apparatus. To: Western Electric Co. (U.S.A.).

A gel of a normally solid polyethylene (5 to 90%), the remainder a viscous normally liquid polyisobutylene.

B.P. 697,812. Thermoplastic adhesive compositions. R. C. McGaffin, A. G. Battaglia. To: National Starch Products Inc.

An aqueous emulsion is produced after coalescence (by solution or fusion) of a thermoplastic resin and a normally solid plasticizer.

B.P. 697,837. Textile spinning and twisting rings. G. F. Albracht.

The supporting annulus is made of a synthetic resin unaffected by oil, not subject to corrosion and not conducting oil by capillary action so as to act as shield between an oil-absorbent ring and broken yarn ends.

B.P. 697,849. Process of embossing plastic sheets. E. Freedman, E. J. Jacob (U.S.A.).

A non-glossy surface is obtained by using an interlayer of fibrous material between embossing die and plastic sheet. The layer disintegrates at least partially under pressure and can then be removed by brushing or washing.

B.P. 697,866. Spring clips. Universal Injection Plastics, Ltd., J. Johnston.

A clothes peg of two identical levers made as plastic mouldings.

B.P. 697,867. Container for articles of rod-like form. J. Shure. To: Mentmore Mfg. Co.

Parallel internal channels (for pencil leads) in flat two-part container.

B.P. 697,875. Containers for dispensing tablets and the like. E. B. Duell (U.S.A.).

Spaced pockets in a plastic container with two-way slideable cover of a transparent plastic.

B.P. 697,883. Method and apparatus for dicing sheet material. To: Union Carbide and Carbon Corp.

Plastic sheets are comminuted for moulding in two stages. First, spaced rotary cutter teeth are passed through the sheet in succession, then the ribbons pass between transversely cutting shears.

B.P. 697,991. Process for the production of copolymers of predetermined composition and the copolymers so produced. To: N.V. de Bataafsche Petroleum Maatschappij (Netherlands).

In the manufacture of heterogeneous copolymers, monomer is added in the course of the copolymerization, e.g., of copolymers of vinyl chloride and vinyl acetate or vinyl chloride and vinylidene chloride.

B.P. 698,007. Polymeric products. To: E. I. du Pont de Nemours and Co. (U.S.A.).

Copolymers of ethylene with an alkyl acrylate and a monoalkyl butene -1,4-dioic acid ester form coatings or films for upholstery, flooring, footwear, wire insulation, sponge products.

B.P. 698,020. Composition and method. To: United States Rubber Co. (U.S.A.).

A homogeneous mixture of a vinyl chloride resin, a plasticizer and a thermoset phenol aldehyde resin is shaped and hardened to an article of outstanding physical properties, water resistance, electrical resistance, flexibility within a wide temperature range, oil and solvent resistance.

B.P. 698,041. Beads for infants. H. H. F. Page.

B.P. 698,066. Sun glasses or like eye protectors. P. Astruck. To: Nordex, Ltd. (add to B.P. 667,640).

B.P. 698,130. Closure for bottles and other containers. S. C. Hart-Still.

A flexible hollow polythene plug moulded in one piece with a deformable diaphragm blocking the hollow part.

B.P. 698,139. A combined seal and liquid dispenser for bottles. S. I. Hitchcock. To: M. and E. Projects, Ltd.

A mushroom-shaped resilient plastic plug with a centre hole is inserted in the neck. The hole is closed under pressure of the cap and opens automatically on removing the cap.

B.P. 698,179. Compositions comprising acid-curing thermosetting aminoplast resins. To: American Viscose Corp. (U.S.A.).

The resin is a urea-formaldehyde. Flow characteristics are not altered by storage.

B.P. 698,187. Buttons. H. L. Pignon. To: H. L. Pignon, Ltd.

The button is moulded from transparent or translucent plastic. The reverse face is indented and painted.

B.P. 698,193. Methyl methacrylate copolymers. To: Röhm and Haas G.m.b.H. (Germany).

B.P. 698,196. Artificial resins and varnishes. To: British Thomson-Houston Co., Ltd. (U.S.A.).

Castor oil and diisocyanate are mixed to obtain a soluble resin. Dissolved in monomeric styrene it forms a varnish. A vinyl polymerization catalyst may be added to produce under heat a solid, tough material for castings, mouldings, laminations.

B.P. 698,215. Polymerization of trifluoroethylene. To: Farbenfabriken Bayer (Germany).

B.P. 698,218. Hydraulic press. H. Gamble, L. Schwarz (Austria).

The action of the hydraulic medium is progressively controlled by the degree to which the material to be impressed (synthetic resin) has been softened. For moulds from type, etchings, etc.

B.P. 698,220. Tubular-lamp fittings. To: Lumalampan A.B. (Sweden).

A sheet of transparent or translucent plastic is bent round fluorescent tubes.

B.P. 698,255. Mouldable articles for application to the human body. K. Egen, M. Schelzig (Germany).

Instead of plaster of Paris, thermoplastic resin mouldings are used which become pliable between 60 and 80° C. (polyvinyl chloride; polyvinyl acetate). They are equipped with an embedded electric heating element and moulded on the human body by pressure or kneading.

B.P. 698,256. Plastic moulded handles for kettles and the like. H. F. Collins, J. A. Ryland. To: Premier Electric Heaters, Ltd.

One end of a reinforcing wire is secured prior to filling the moulds to a moulded-in screw, the other end may be positioned in the second screw with free axial movement.

B.P. 698,266. Method of coating flexible sheet materials and sheet material produced thereby. To: Gevaert Photo-Produkten N.V. (Netherlands).

The coating composition containing a plasticized polyvinyl chloride or a copolymer thereof is applied directly as a powder and bonded to a fabric base by heat and pressure.

B.P. 698,294. Device for protecting various portions of the anatomy. V. L. Kelly.

Spaced guards for keeping an injured finger protected from contact with unclean surfaces.

B.P. 698,300. Polysiloxane resins. To: British Thomson-Houston Co., Ltd. (U.S.A.).

Lead tetraphenyl catalysts effect quick curing of polysiloxane resins at lower temperature.

B.P. 698,329. Process for manufacturing paints and coloured plastics. Postans, Ltd., M. H. M. Arnold.

Powdered pigment is dispersed in carrier liquid of low viscosity, then the carrier is mixed with the plastic preparation.

B.P. 698,346. Pistons of fluid-operated jacks. R. B. Elliott. To: Hymatic Eng. Co., Ltd.

A sleeving of rubber or plastic (polythene or "Fluon") may be used.

B.P. 698,353. Synthetic resins capable of binding organic atom complexes and process for preparing same. N.V. Centrale Suiker Maatschappij, L. J. Kantebeen (Netherlands).

m-Phenylene diamine and formaldehyde are condensed in the presence of nitric (phosphoric, sulphuric, hydrochloric) acid. The new resins are particularly important for the decolorization of sugar solutions.

B.P. 698,359. Production of vinyl chloride polymers. L. Harris. To: I.C.I., Ltd.

Spherical polymer particles up to about 2μ may be produced (for pastes) by emulsifying a compound containing at least 50% vinyl chloride under the influence of a monomer-soluble catalyst in the presence of one water-soluble and of further monomer-soluble emulsifying agents.

B.P. 698,374. Apparatus for feeding powder in a continuous stream. F. E. Stirn, A. S. Taylor. To: American Cyanamid Co. (U.S.A.).

The feed hopper (pharmaceutical industry) should be constructed of transparent vinyl, acrylic or styrene material.

B.P. 698,375. Surface treatment of fibre boards. B. Odland (Norway).

Coalescing layers of plastic (urea-melamine-formaldehyde) are applied to the board. The first applied (inner layer) carries the desired coloured pattern.

B.P. 698,418. Powder dispensing container. B. Strong, K. J. Huichins. To: E. Shipton and Co., Ltd.

Container and stopper may be of polythene.

B.P. 698,434. Manufacture of electric cables. H. J. Dixon. To: British Insulated Callender's Cables, Ltd.

The cable body (polyethylene) is provided with small serrations. When applying the metal (aluminium) sheath the ridges are deformed and pressed partly into the adjacent grooves but the body remains supported by the sheath.

B.P. 698,443. Method for emulsifying polymerizable compounds and effecting polymerization with the emulsion. To: Dow Chemical Co. (U.S.A.).

B.P. 698,486. Manufacture of reels or bobbins. W. Travis, R. H. Atherton. To: Industrial Reels, Ltd.

A reinforcing sleeve is bonded to the injection-moulded flanged barrel.

B.P. 698,490. Process for dyeing filaments, fibres, bristles, fabrics, films and like-shaped articles of linear polyesters. R. Hardwich, E. Walters, I.C.I., Ltd.

The polyesters are dyed in aqueous medium at superatmospheric pressure and at over 100° C.

B.P. 698,491. Extrusion of thermoplastic materials. D. Hartland. To: Bakelite, Ltd.

The extrusion die comprises a body portion and a tip, the temperature of each of which is independently adjustable. A heat-insulating barrier is clamped between body portion and tip. High-gloss or matt finishes may be obtained merely by heat control at the die tip.

B.P. 698,511. Process and apparatus for making helical coils of flexible thermoplastic rod. L. J. Moncrieff. To: British Celanese, Ltd.

The softened rod is wound on a rotated frusto-conical winding surface.

B.P. 698,531. Flower holder. G. C. West.

B.P. 698,572. Grinding wheels and like abrasive bodies. To: Norton Grinding Wheel Co., Ltd. (U.S.A.).

Organic polymer bond selected from a group including thermosetting phenol formaldehyde or aniline formaldehyde resins and others.

B.P. 698,584. Holders for sheets, cards, licences and the like. M. Zell.

Ring and disc of thin highly polished and very flexible polyvinyl chloride sheet adhering firmly to glass (car licence).

B.P. 698,603. Moulded plastic container for tyre valve cores. S. T. Williams. To: Scovill Mfg. Co. (U.S.A.).

Made of a light-permeable synthetic resin with "eye appeal."

B.P. 698,605. Method of coating metal surfaces. To: Dr. Alexander Wacker Ges. fuer Elektrochemische Ind. G.m.b.H. (Germany).

More stable lacquer coatings, especially on metals in the electrical, chemical and foodstuff industries, are obtained by applying a primary coating of a polyvinyl acetate resin including another resin and a modifying substance under a cover of a silicon resin.

B.P. 698,607/608. Tubular containers for electrical condensers or other apparatus. P. A. Sporing. To: Telegraph Condenser Co., Ltd. (add. B.P. 584,801).

Polytetrafluorethylene is employed as the resilient material of which the bungs are formed.

B.P. 698,614. Goggles or eye shields. L. Kustow, I.C.I. Ltd.

The frame may be of polythene or polyvinyl chloride, the window of methyl methacrylate.

B.P. 698,618. Plasticized vinyl halide resins and electrical conductors insulated therewith. To: British Thomson-Houston Co., Ltd. (U.S.A.).

B.P. 698,632. Injection moulding machines. R. H. Windsor, Ltd., S. C. H. Smith.

The plasticizing chamber is formed of an outer barrel and an inner spreader with a bulbous nose and radial fins defining a conical cavity. The plugs of material are stepwise forced forwards and gradually plasticized leaving an inner unplasticized core which becomes smaller at each stroke until each plug is plasticized throughout when reaching the forward narrow end.

B.P. 698,633. Container for powders. Universal Metal Products Ltd., M. Biddulph.

A beaker (moulded plastic) with a domed lid having small holes for sprinkling and a large hole for pouring.

B.P. 698,653. Ophthalmic mountings. A. K. Marsters. To: American Optical Co.

B.P. 698,703. Method and apparatus for preparing a cellulose board and the resulting product. To: Curtis Co.'s (U.S.A.).

Five to eight per cent. of dry powdered phenol formaldehyde resin are incorporated.

B.P. 698,705. Mountings for electronic valves. General Electric Co., Ltd., W. P. Cole, S. Benjamin.

A moulded or machined polytetrafluorethylene plug is used for mounting a subminiature electronic valve.

B.P. 698,721. Injection moulding and die-casting methods and moulds for use therewith. G. M. Mejlso, E. S. Heimann.

The example describes an injection mould for the flywheel and two pinions of a toy motor. The arrangement of the gate unit attached at spots on top of the three mouldings makes breaking off easy.

B.P. 698,766. Sealing cap. M. A. O. Debacq (France).

B.P. 698,772. Method of manufacturing optical, aspherical correction elements. To: N. V. Philips' Gloeilampenfabrieken (Netherlands).

B.P. 698,833. Wrapper or cover. G. C. Abel. To: Assoc. Newspapers, Ltd.

A sheet (e.g. of polyvinyl chloride) having cables along its peripheral edges.

B.P. 698,914. Cap, cover or other closing member for receptacles. M. A. O. Debacq (France).

B.P. 698,918. Electric cables. To: Soc. Industrielle de Liaisons Electriques (France).

The protective cover is made of polyvinyl chloride.

B.P. 698,928. Flywheel for toy and method of production by injection moulding or die casting. G. M. Mejlso, E. L. Heimann.

Disc laminations of sheet metal secured together by a plastic core (cellulose acetate) moulded in place.

B.P. 698,929. Ophthalmic mounting. E. M. Splaine. To: American Optical Co.

B.P. 698,948. Aqueous dispersions of cellulose glycolic acid or carboxymethyl hydroxyethyl cellulose and water-insoluble coatings, films and adhesives made therefrom. To: American Machine and Foundry Co. (U.S.A.).

B.P. 698,959. Device for drawing equally-spaced parallel or divergent lines or hatchings. N. Kutchukian (France).

B.P. 698,992. Stoppering device for mineral water bottles and other applications. To: Soduvoc S.A. (France).

A thick cap with internal sleeve and outer skirt to be torn when opening the bottle. Preferred material is polystyrene.

B.P. 699,014. Manner of manufacture of contact lenses. To: Mueller-Welt G.m.b.H. (Germany).

The central portion of a moulded transparent acrylic sheet shows so little irregularity that the new method simply uses a concave matrix having a central bulbous depression for iris and pupil into which the heated sheet is blown by air pressure while secured around the matrix along the marginal parts, which are severed afterwards.

B.P. 699,016. Production of vinyl chloride polymers. B. S. Dyer, A. A. Gibson. To: I.C.I. Ltd.

B.P. 699,055. Hand guards. O. J. C. Kozak.

To prevent cuts should the (carving) knife slip, a plastic thimble with an upstanding wing and a slot underneath so that the finger can rest directly on the fork.

B.P. 699,060. Embossing of thermoplastic film. M. A. Chavannes.

Embossed on carrier belt while hot by cool continuously moving embossing face.

B.P. 699,077. Protection of articles against corrosion, abrasion or the like. B.B. Chemical Co., Ltd., I. R. Cooper, A. D. Woods.

The composition comprises a vinyl chloride/vinylidene chloride copolymer, a chlorinated rubber and an organic-solvent. The coating can readily be stripped off when it has served its purpose.

B.P. 699,089. Refractory articles. A. E. Williams. To: Nat. Res. Development Corp.

The articles are preserved for periods up to six months by a coating of polyvinyl chloride applied as an emulsion.

B.P. 699,181. Colour comparator apparatus. R. Adler (Canada).

Colour standards of flexible plastics are used.

B.P. 699,185. Pigmented compositions and their preparation. B. F. Goodrich Co. (U.S.A.).

B.P. 699,193. Vinyl chloride resin compositions and articles. To: Firestone Tyre and Rubber Co. (U.S.A.).

An aminoplast condensate or resin is incorporated in a vinyl chloride resin and organic cadmium compound (plasticizer). composition. For films, artificial leather, etc.

B.P. 699,274. Electrical capacitors. F. J. P. J. Burger, A. H. Bond. To: British Dielectric Research, Ltd.

The dielectric is, e.g. polystyrene or polytetrafluoroethylene.

B.P. 699,292. Heat-resisting and heat-insulating materials. W. F. Locke. To: Fireproof Tanks, Ltd.

The metal is covered with a layer of woven glass or quartz fabric impregnated with a vinyl resin, a vinylidene resin or a halogenated hydrocarbon polymer.

B.P. 699,465. Goggles or eye shields. L. Kustow.

B.P. 699,467. Interference filter arrangement. To: Carl-Zeiss-Stiftung, Jenaer Glaswerk Schott and Gen. (Germany).

The bi-refringent layer is a stretched film of synthetic material (cellulose hydrate film).

B.P. 699,481. Plate. W. D. Lumley.

Moulded body for holding hot water under food to keep it warm.

B.P. 699,536. Lighting fittings. R. G. P. Mitford. To: Motor and Air Products, Ltd.

Cover and refracting elements made of "Perspex."

B.P. 699,578. Shipping and display case for electric shavers and the like. I. Jepson, F. E. Cerveny. To: Sunbeam Corp.

B.P. 699,579. Fishnets formed of synthetic resin strands and strands therefor. To: Heminway and Bartlett Mfg. Co. (U.S.A.).

The stretched core (of nylon, Orlon or Terylene) has a resilient coating of a water-insoluble synthetic resinous material.

B.P. 699,587. Container for food and like perishable articles. G. R. Judkins.

Refers to "food safes" made, e.g., of thin strips of plastic.

B.P. 699,665. Method and composition for production of cellular thermoplastic products. C. E. de Long. To: Dow Chemical Co.

Panels, planks, beams of certain cross section are made of solid masses of individually closed cells with thin walls of thermoplastic resin (polystyrene) incorporating a stearate and a normally gaseous agent.

B.P. 699,671. Moulding of synthetic resin. E. H. Nordin (Sweden).

To avoid contraction, a catalyst is applied to the mould surface which initiates polymerization so that the layer nearest to this surface hardens faster than the rest of the material. Methyl (polymethyl) methacrylate and dimethyl aniline are used for anatomical or dental prostheses.

B.P. 699,683. Surface decoration of polyvinyl chloride sheet and fabrics coated with polyvinyl chloride. G. F. P. Parsons. To: B.X. Plastics Ltd.

The sheet is embossed at a temperature below its softening point, a layer of plastisol spread over the embossed sheet and a special heat treatment applied.

B.P. 699,700. Vibration record carrier. To: Loewe Opta A.G. (Germany).

The carrier is a helical tape of plastics produced by grooving a cylinder.

B.P. 699,734. Manufacture of wear-resistant articles or materials. M. Littmann, J. W. Buckley, Metro-Cutanit, Ltd.

Carbide of tungsten, molybdenum or titanium in powder form is incorporated as a surface reinforcement in a relatively soft base material.

B.P. 699,736. Manner of manufacture of contact lenses. To: Mueller-Welt G.m.b.H. (Germany).

A ring of textile fabric of the diameter of the natural iris is assembled in contact with the inner surface of a shell of transparent thermoplastic material. A layer of transparent plastic material is added and the whole united by heating under pressure. The appearance of the iris ring may be improved by the incorporation of coloured threads of sheep wool.

B.P. 699,755. Plastic-coated leather and method of making same. R. Hagen (Germany).

B.P. 699,786. Hair curler. R. E. Harvuot, A. J. Jones.

Use is made of vinyl chloride tubing to obtain more comfort when wearing the curler.

B.P. 699,799. Drums. C. F. Hammond, W. Shackleton.

The metal shell is lined by a polythene bag anchored all round its upper edge.

B.P. 699,822. Eye elements for dolls and the like. D. G. Todd, J. Robinson.

B.P. 699,928. Pourers for bottles or like containers. H. Lehmann.

The spout can take up two positions, downwardly into the bottle or pointing upwardly through an aperture provided in the screw cap.

B.P. 699,951. Production of organic polymers containing phosphorus. To: Glenn L. Martin Co. (add to B.P. 688,372).

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B.P. 700,008. Ball-point pen. G. J. Marlow.

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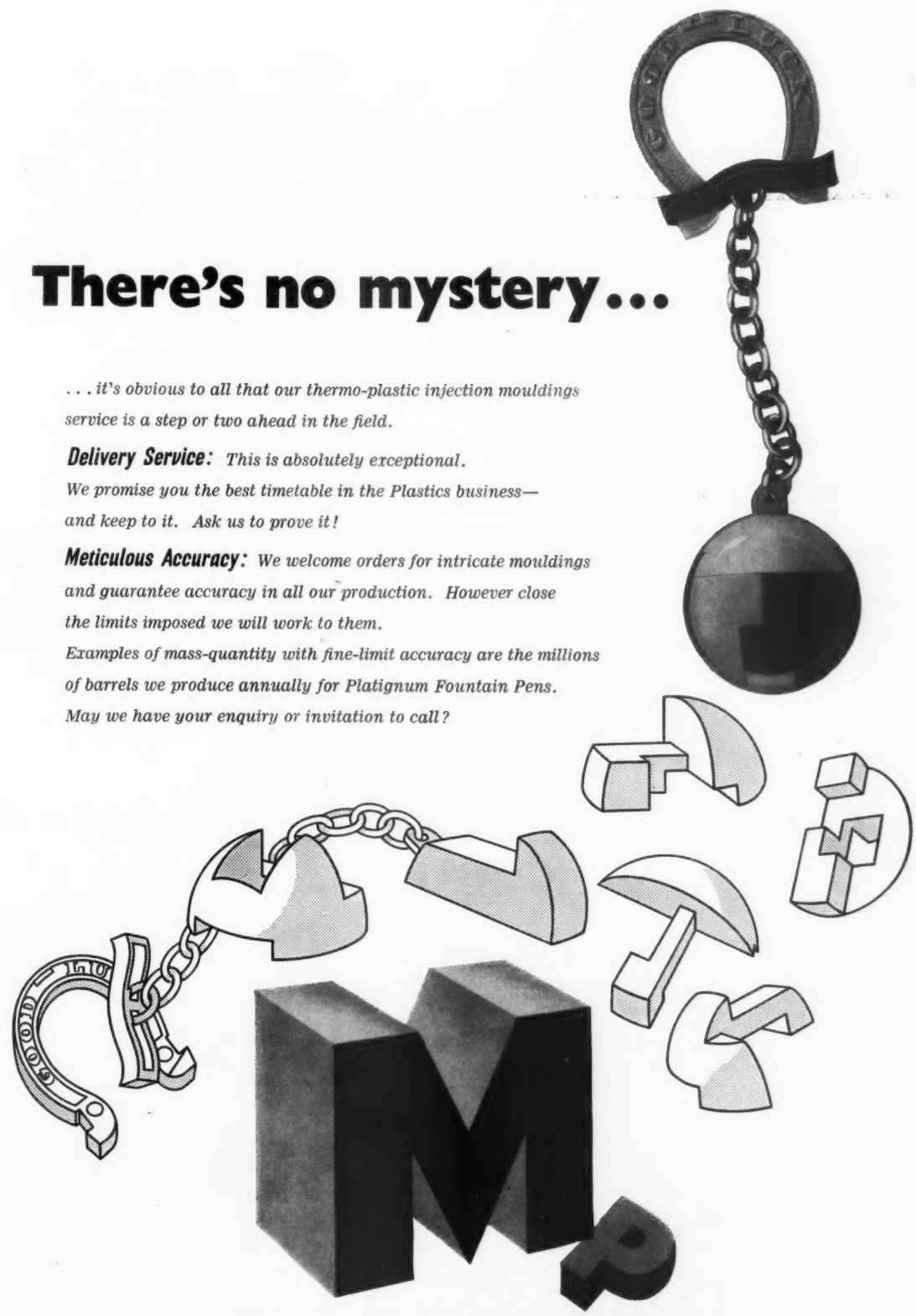

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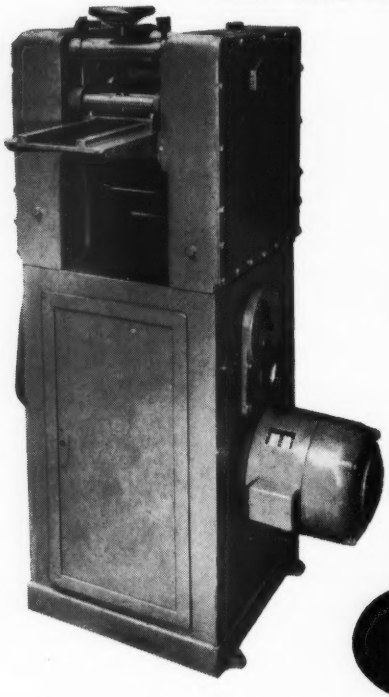

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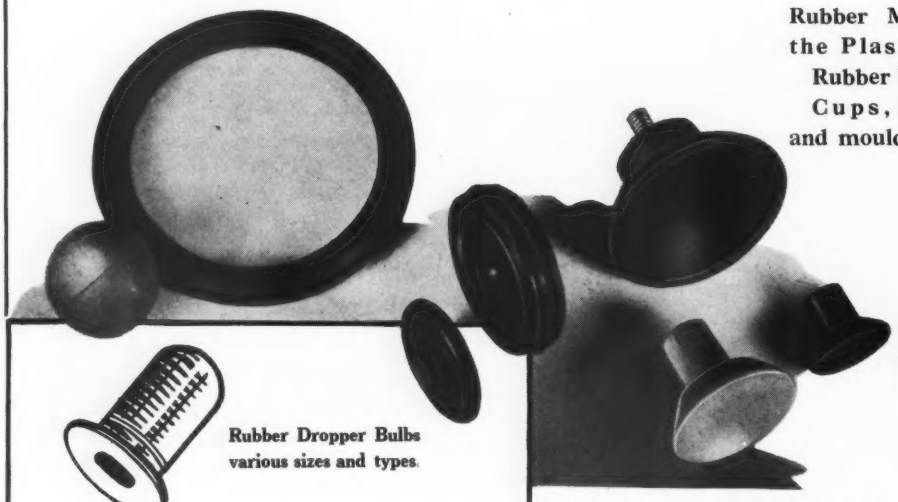

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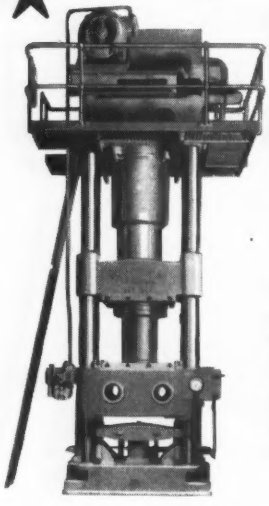

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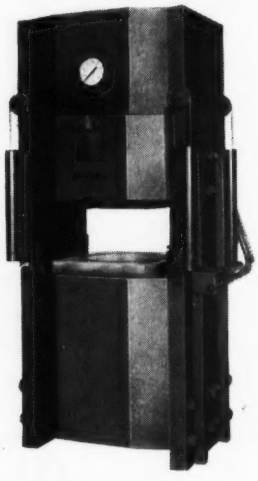

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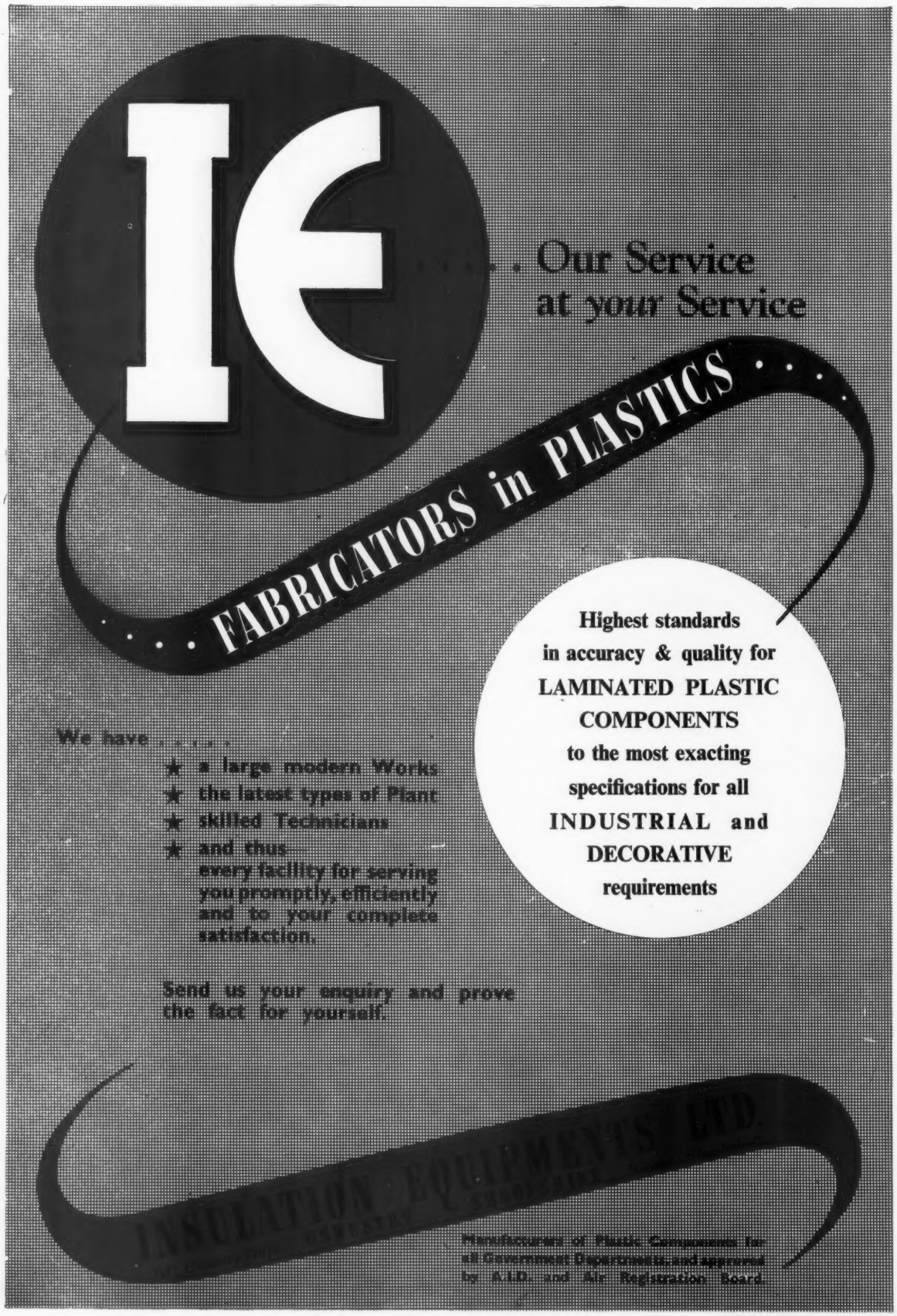
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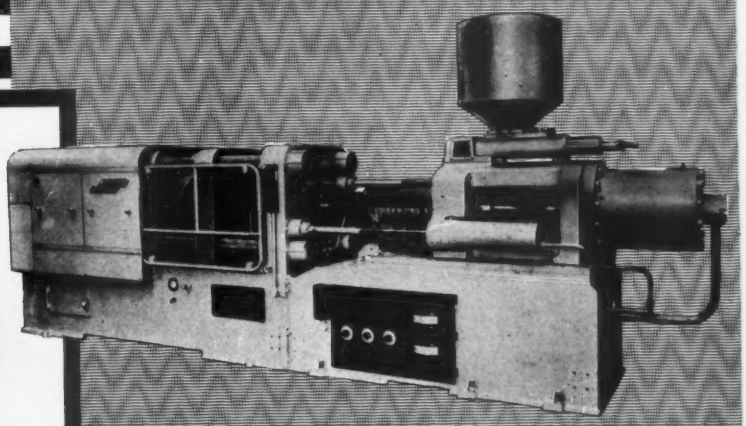

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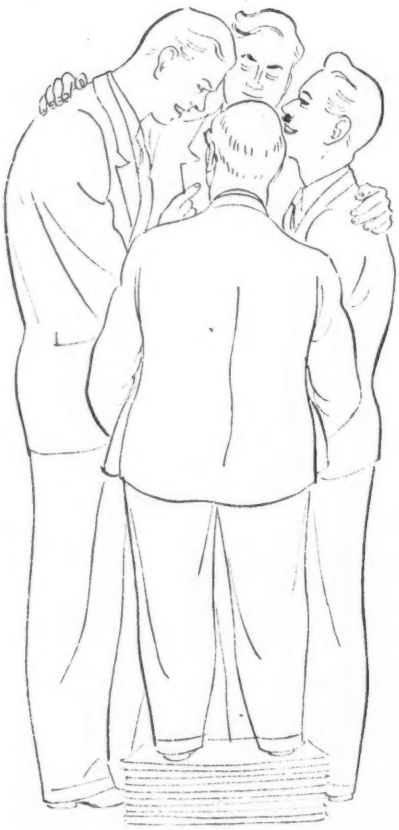

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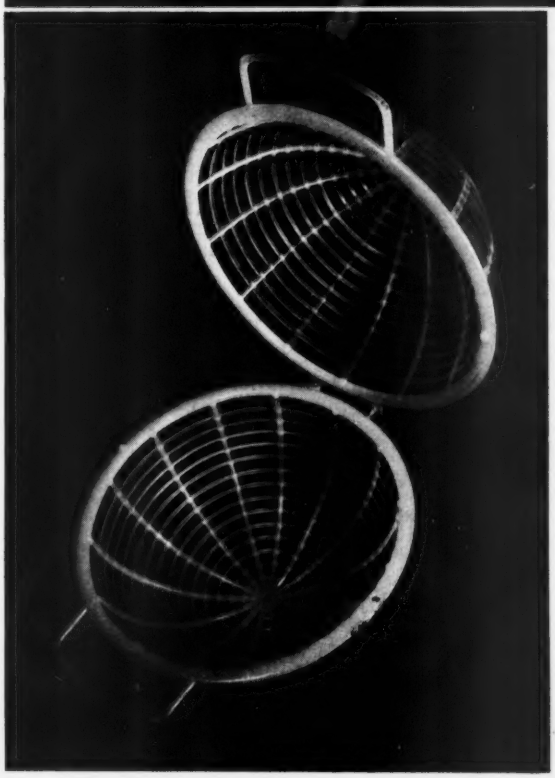

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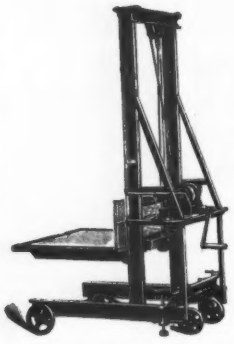

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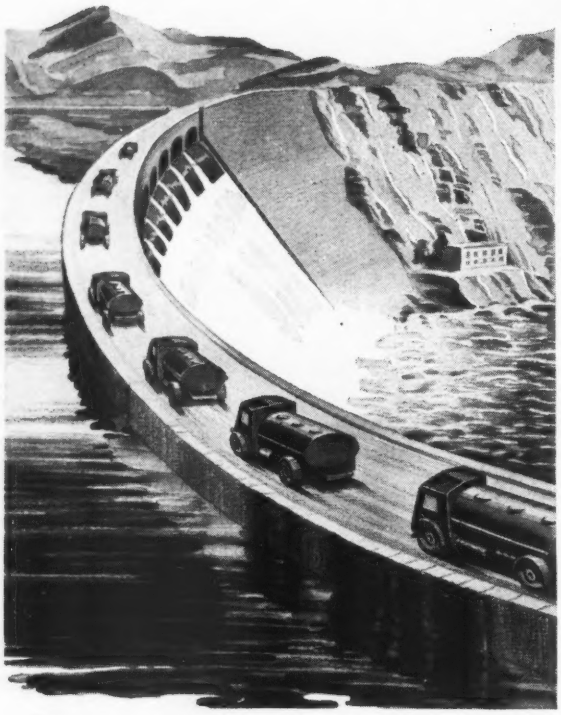

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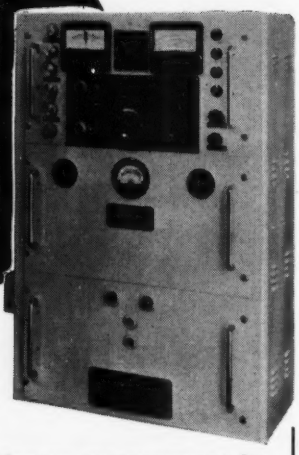

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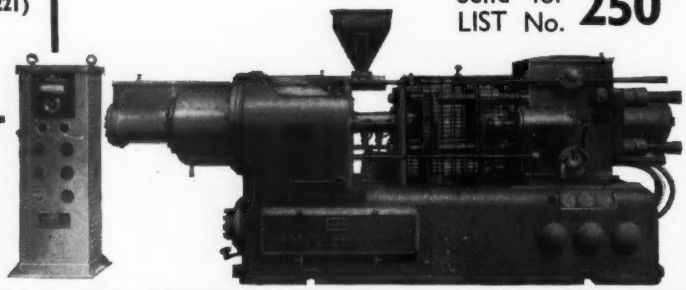

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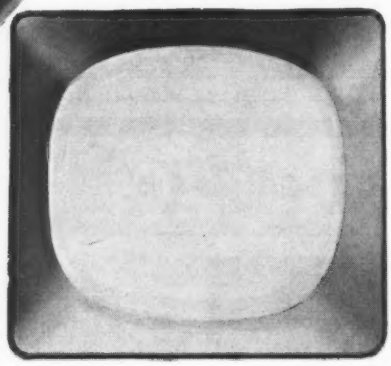

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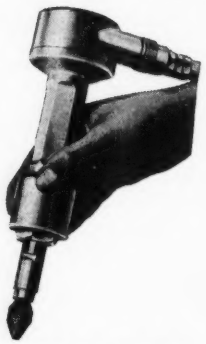

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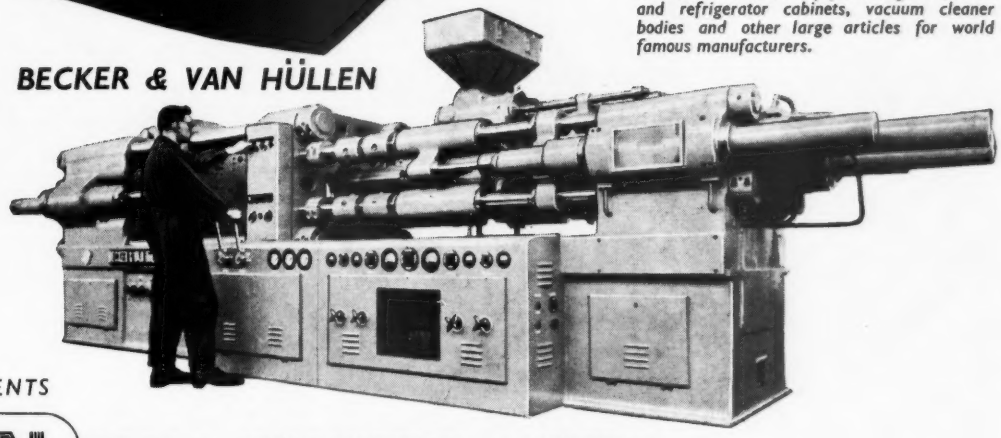

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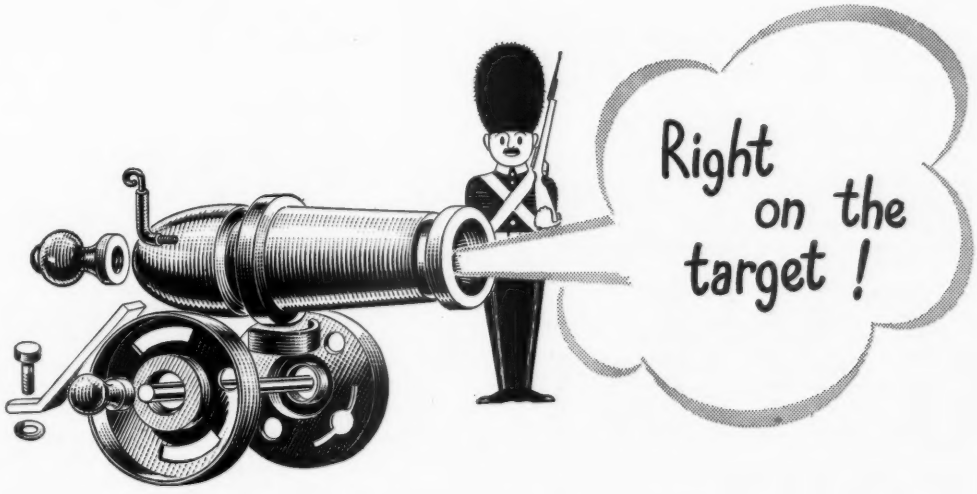

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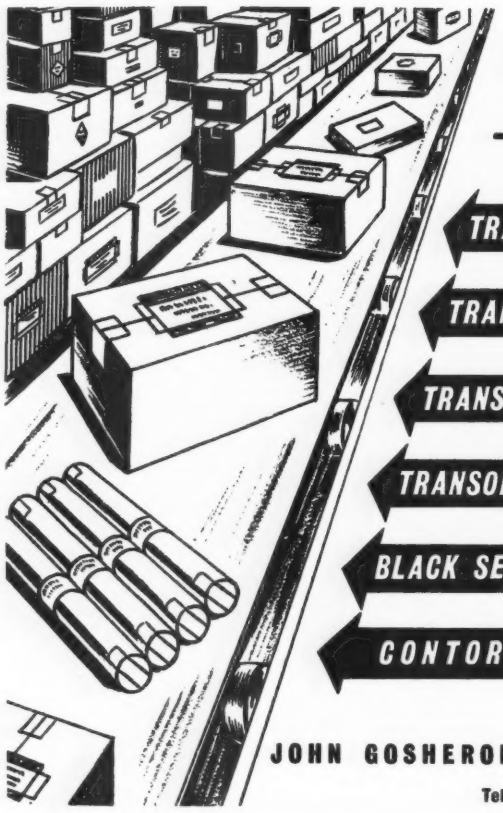

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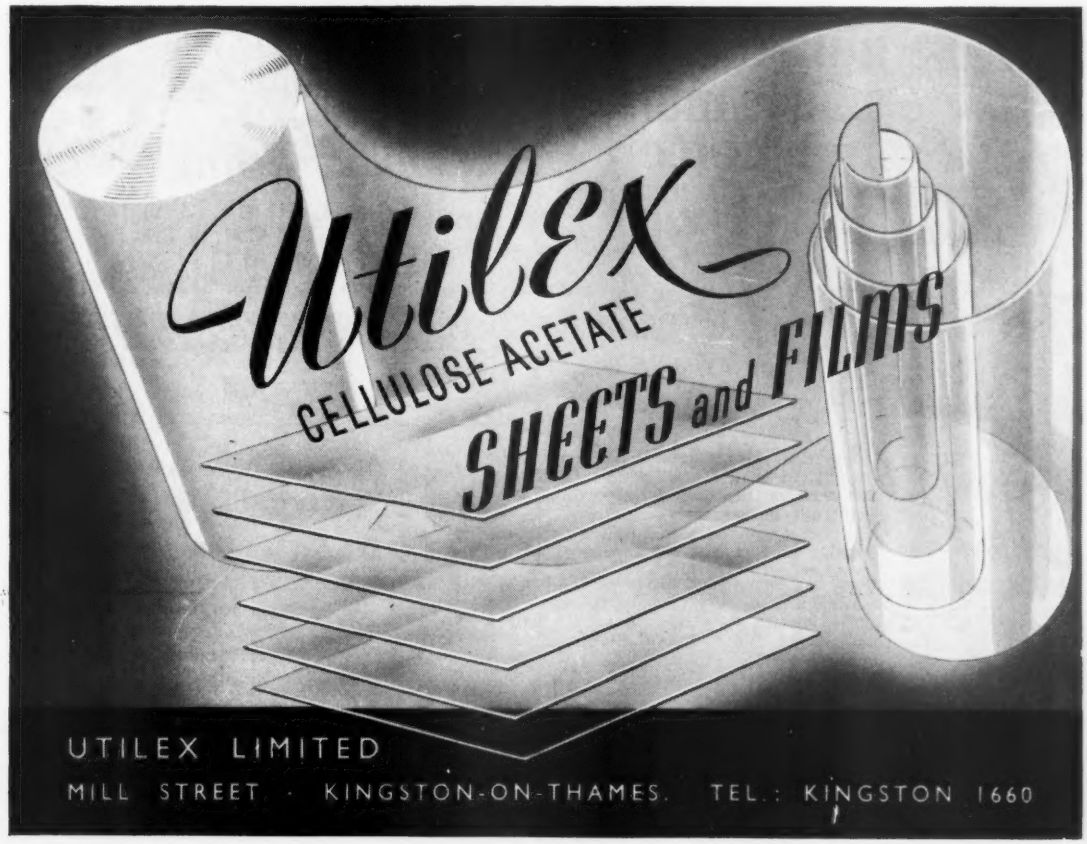

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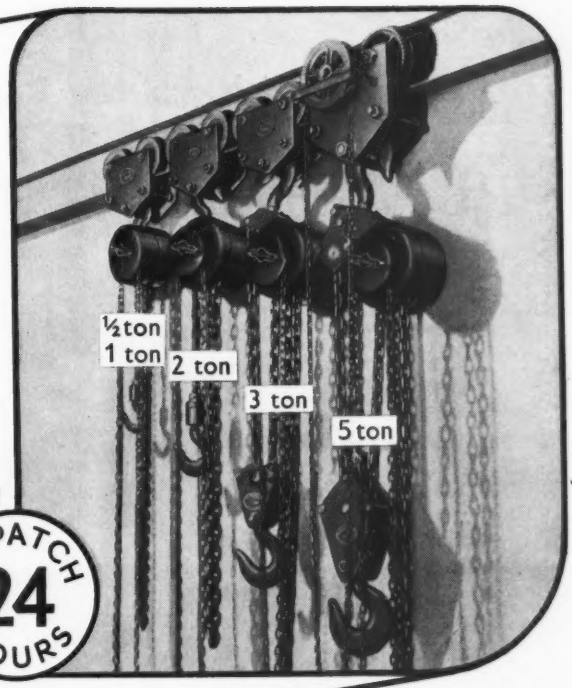

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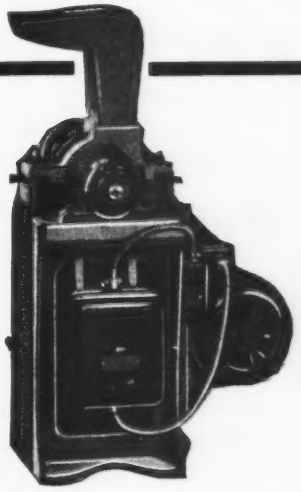

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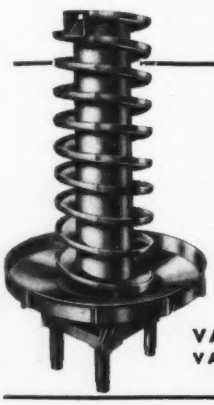

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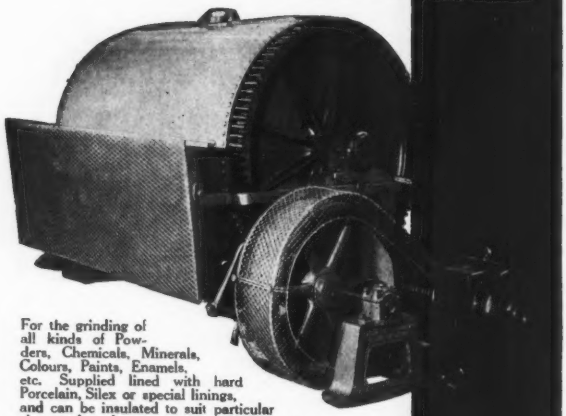

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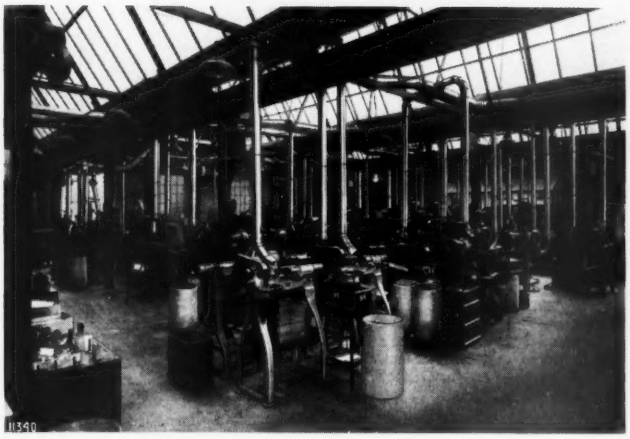

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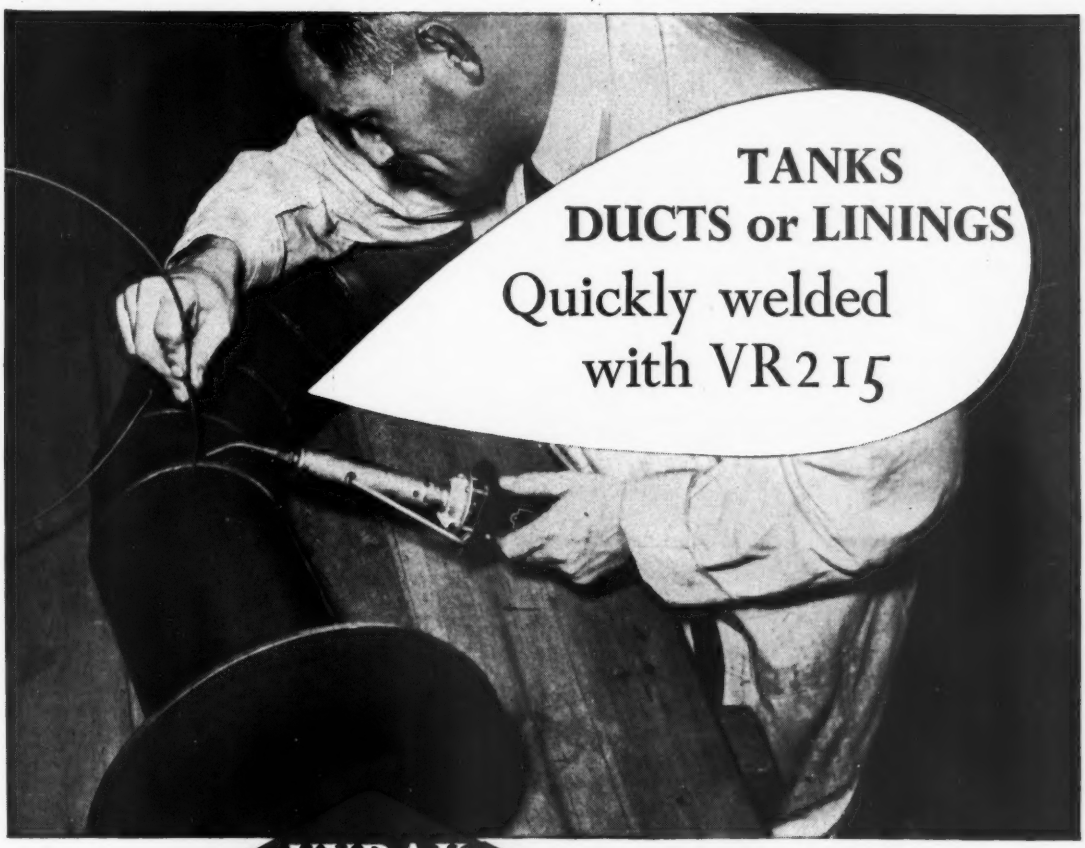

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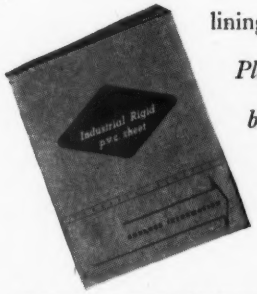

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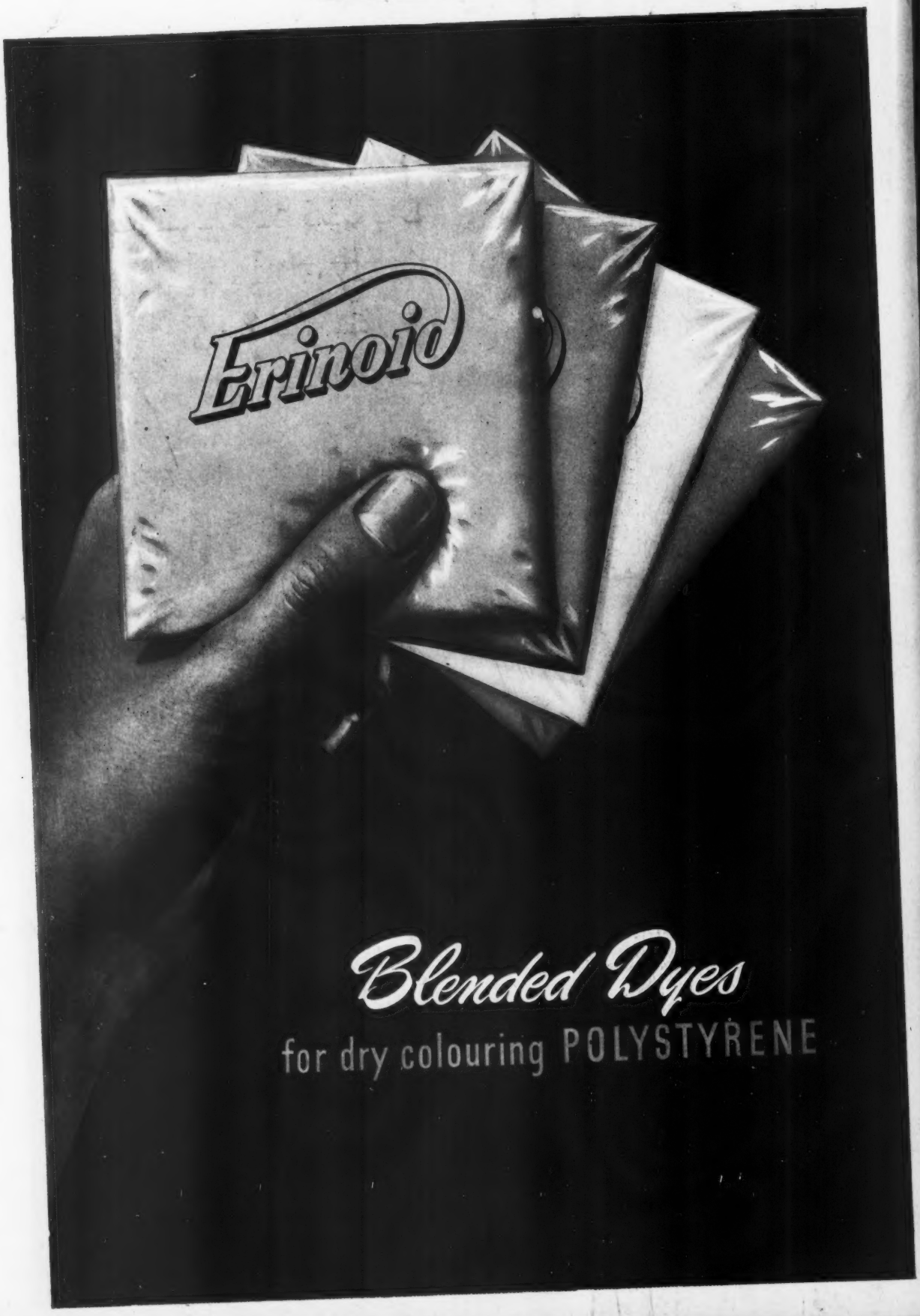

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